Vol. LXXXVIII NOVEMBER, 1928 No. 5

NOV 9 1928 Medical Lib.

ANNALS of SURGERY

NOV 9 19

A Monthly Review of Surgical Science and Practice

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Official Publication of the American Surgical Association, of the New York Surgical Society and the Philadelphia Academy of Surgery.

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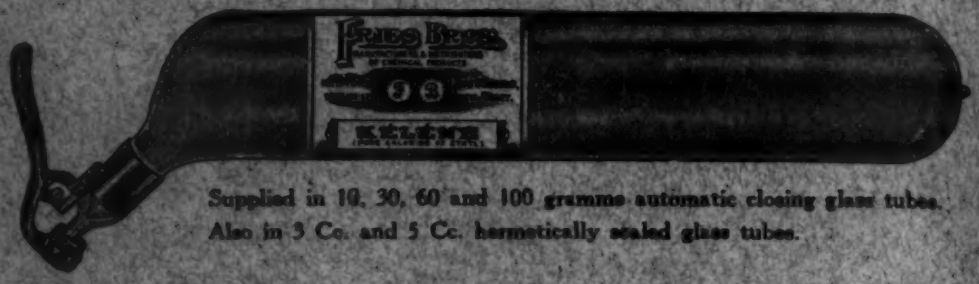

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ANNALS *of* SURGERY

VOL. LXXXVIII NOVEMBER, 1928 No. 5

SUPPURATIVE PERICARDITIS FROM THE SURGICAL VIEWPOINT*

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THIS paper is based upon a study of the literature and a series of cases under my care at the Episcopal Hospital, and one at the Abington Memorial Hospital. It will deal with the subject of suppurative pericarditis from the surgical standpoint.

Pericarditis was known to the early writers on natural philosophy, although we have no record that Hippocrates was familiar with it. We find that Galen (131–201 A.D.) noted it in animals and characteristically made the bold deduction that man could likewise suffer from the disease.[1, 2] But centuries elapsed between these first recorded descriptions of the disease and even the suggestion of an operation for the relief of a particular form of it; for it was not until 1649 that Riolan[3] first advocated pericardiotomy for the relief of pericardial effusion, his plan being to trephine the sternum, and from this date down to 1819 numerous authorities were courageous enough to suggest and even to recommend the operation of pericardiotomy, one advocating a certain approach, another a different one, but we know of no successful operation throughout this period of one hundred and sixty-nine years. Thus, Senac,[4] 1749, described pericardial effusion and recommended incision into one of the left intercostal spaces for its relief. Morgagni,[5] 1761, appreciating the dangers resulting from the accumulation of fluid in the pericardium, hoped for an improvement in diagnostic means which would warrant resorting to paracentesis for its relief. Corvisart,[6] 1806, argued that the diagnostic difficulties presented unsurmountable obstacles to the employment of any such measures. Even after Corvisart,[7] 1811, published the modest Auenbrugger's discovery of precordial bulging and increased cardiac percussion dulness as a point in diagnosis, the diagnostic stumbling blocks stimulated Laennec,[8] 1819, to wield his powerful influence in the argument against paracentesis. In his immortal "Traité de l' auscultation" the very year, by the way, in which he invented the stethoscope, he advised Riolan's plan of trephining the sternum. His clinical assistant, Collin (1824), interpreted the friction rub previously described by Laennec as "the squeak of the leather of a new saddle under the rider," but wrongly ascribed it to dryness of the sac.[9]

The involved problems of diagnosis, however, were not the only barriers to the early employment of surgical means of treating pericarditis. From the earliest times the heart was regarded with a certain superstitious awe, and

*Annual Oration in Surgery, read before the Philadelphia Academy of Surgery, April 2, 1928.

there was no doubt a certain degree of inherited apprehension which prevented any unnatural interference with an organ, enjoying the reputation which had been its own since Aristotle taught the doctrine of the primacy of the heart. Pioneers in this field probably treated the heart with superstitious deference, and would naturally hesitate long before interfering in any way with the "central abode of life and the soul." [10]

For these reasons it is not surprising, then, to find that it was not until 1819 that the first successful pericardiotomy was performed. It is true that Desault,[11] as early as 1798, attempted by surgical means to evacuate what he thought was a pericardial sac full of pus, but he was unsuccessful because his diagnosis was wrong. Larrey,[12] likewise, met with failure when he performed an operation for the same purpose by a different route, namely, the left costo-xyphoid.

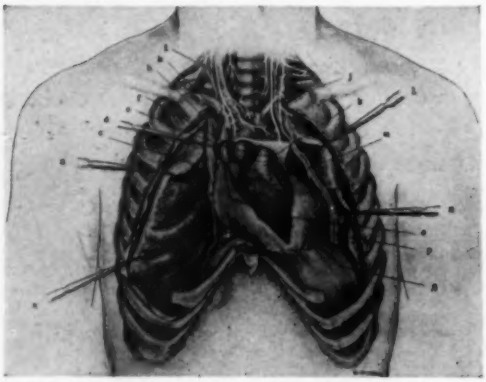

FIG. 1.—"Bickham's Operative Surgery," vol. iv, Fig. 3261, p. 2. Courtesy W. B. Saunders and Co., Philadelphia.

For many years *paracentesis* seemed to hold favor among surgeons (Jowett,[13] 1827; Skoda and Schu[14]), and this was practiced by the Russians in their large and remarkable experience in hemopericardium, during an epidemic of scurvy in Cronstadt and the Baltic provinces.[15] In isolated instances, however, surgeons were known to *incise* the pericardium. Thus, Hilsman,[16] as early as 1844, was the first to perform pericardiotomy in a case of suppurative pericarditis, the type with which we are dealing in this paper. He incised the fourth interspace and evacuated several tumblerfuls of pus, keeping the wound patent subsequently by daily probing, with a successful result; and von Langenbeck[17] operated in two similar examples of this disease in 1850. Patients suffering from non-suppurative pericarditis were operated upon many years before, however. For example, Romero,[18] of Barcelona, performed the first successful pericardiotomy in 1819, having secured recoveries in two patients out of three operated upon for non-suppurative pericardial effusion.

After Trousseau and Lesague[19] gave the weight of their influence to the discussion, enough cases began to accumulate to warrant collecting them in the literature; thus Günther,[20] 1861, found records of twenty-two punctures; Roger,[21] 1875, culled fourteen from the French literature, and Roberts,[22] 1876, found forty-one cases to which he added thirteen new ones; Kindenberg[23] brought the total to sixty-five in 1879, and West[24] to seventy-nine in 1883. Delorme and Mignon[25] collected records of eighteen incisions and sixty-two punctures in 1895. Since then Roberts[26] (1897), Porter[27] (1900), Eliot[28] (1909), Rhodes[29] (1915), and Pool[30] (1921), have collected the

recorded cases of pericardiotomy for suppurative pericarditis. To Rhodes' group of eighty-six, Pool [30] added sixteen cases from the literature and one of his own, nine of the seventeen cases recovering. This brought Rhodes' statistics to a total of 103 cases, with fifty-four recoveries and forty-nine deaths.

I have endeavored in this paper to collect the reported cases from the literature since those given by Pool in 1921, together with several presented for the first time in this communication. I have performed pericardiotomy for suppurative pericarditis successfully in two out of three cases, and a fourth time by mistake in a case of cardiac decompensation from valvular disease. This brings the above total to 106 cases of suppurative pericarditis, with fifty-six recoveries and fifty deaths. In the cases collected from the literature since 1921, I have found records of fifteen recoveries and five deaths, making the grand total of seventy-one recoveries and fifty-five deaths.

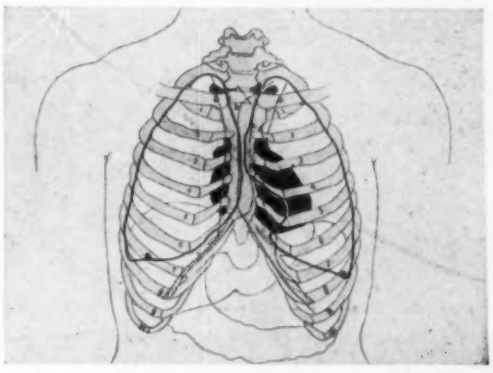

FIG. 2.—"Bickham's Operative Surgery," vol. iv, Fig. 3260, p. 2. Courtesy W. B. Saunders and Co., Philadelphia, Pa.

It is interesting to pause a moment to note the prominent part played by Philadelphians in the history of pericardial surgery. One of our own members the late Dr. John B. Roberts,[31] who occupied the President's Chair in this Academy in 1906, was one of the chief American contributors. In 1876, while an interne, he searched the shelves of the Pennsylvania Hospital Library for records of pericardiocentesis, later publishing the fruits of his labor. From that time till 1923, he not only contributed valuable communications on this and related subjects, but invented and used a practical trocar for performing pericardiocentesis with a minimum of danger. The distinguished retiring President of the College of Physicians, Dr. Hobart A. Hare,[31] performed experiments in 1886–1887 showing that the deleterious effects of hemopericardium were due to distention of the sac; and, more recently an important contribution to this subject has been presented by Wood and Bradley.[32]

The incidence of suppurative pericarditis is not excessively low. Its clinical frequency is given by Klose and Strauss [33] as one in every 6,000 of clinical disease, but this probably varies. Thus, there were found only three cases of suppurative pericarditis in 37,130 patients treated at a general hospital handling 6,114 bed and 31,016 dispensary cases in the year 1925–1926,[34] although Stone [35] noted purulent pericarditis in 15.5 per cent. of 300 patients dead of pneumonia, a figure higher than the generally accepted average.

Perhaps this variation in figures, of which the above is only an example, has its explanation in the parallel fluctuations in the number, nature and severity of the complications of pneumonia, for it is this latter disease which

furnishes us with a considerable portion of pericarditis (34 per cent. of Preble's cases occurred in pneumonia,[36] the *greatest* proportion being of the purulent form). It should not be surprising, therefore, to find that, like the mobile statistics of pneumonia, those for pericarditis reflect similar notable variations and apparent contradictions. Rheumatic fever and chorea (in which suppuration is thought by some to follow the dry or plastic stage in certain instances) are perhaps of even greater importance in the etiology of pericarditis, but they occupy a far inferior rank if only suppurative cases are considered. On this point the statistics are conflicting. Preble,[36] for example, finds rheumatic fever associated with 28.36 per cent. of pericarditis cases as opposed to 34 per cent. for pneumonia, while Sears[37] noted inflammatory rheumatism in 51 per cent. of his 100 cases, and a history of previous rheumatic infection in forty others. Osler,[38] on the other hand, found pericarditis in 6 per cent. of 330 cases of rheumatic fever, and in nineteen of seventy-three chorea necropsies, while Zinn[39] observed pericarditis in 10 per cent. of 1000 cases of rheumatism, and Sibson,[40] in sixty-three of 326. These, of course, did not all progress to the purulent stage, but some idea of the proportion of suppurative cases to those of mere effusion is given by Hedblom[41] who reports 21 per cent. of purulent cases in 100 effusion autopsies at the Mayo Clinic for the period of 1910–1922. It is clear from the above that the two outstanding diseases with which pericarditis is associated are pneumonia and rheumatic fever.

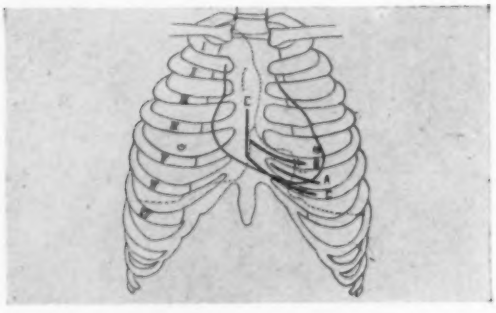

FIG. 3.—"Bickham's Operative Surgery," vol. iv, Fig. 3265. Courtesy W. B. Saunders and Co., Philadelphia.

But suppurative pericarditis may be secondary to a variety of *other infections,* such as tuberculosis,[42] septic processes (especially of bone and puerperal fever),[43] gonorrhœa;[44] and it may also occur in fevers like scarlatina[45] as well as in typhoid fever.[36] Sinnhauer[44] lists cases complicating meningitis, malaria, erysipelas, and leukemia; syphilis is a rare cause.[46] One might expect to find this complication more frequently in double or right-sided pneumonia, since pneumonia on the left side is encountered less often,[47] and the bilateral disease is more severe and should therefore be expected to give a higher incidence of complications; but writers differ on this point. Chatard[48] found that right-sided pneumonias are more apt to be followed by pericarditis, but Preble[36] maintains that the danger is greater in the left-sided affection. Observers are surprised and often embarrassed to find that they have overlooked purulent pericardial exudates, as terminal complications of gout, chronic nephritis, arteriosclerosis, scurvy, pleurisy, aneurism, diabetes, and various other chronic illnesses, including certain types of hepatic cirrhosis.[49] It is perhaps to the insidiousness of these curious terminal manifestations that the

disease owes the reputation given it by Osler,[50] as probably the most commonly overlooked serious disease. In such instances, it is not found because it is not sought for, as a rule. Some of these latent cases are tuberculous.

Tuberculosis, however, is usually secondary, extending from mediastinal or tracheo-bronchial lymph-nodes, lungs, pleuræ, or as part of a general miliary infection or polyserositis.[42] It is not a common cause. For example, Hedblom [42] states that Wells found only eight cases of tuberculous pericarditis in 1048 autopsies, while Metcalf noted pericardial involvement in only 5 per cent. of cases of active tuberculosis. Primary Koch's infection is much less frequent than secondary, for this same author says that Willgk found only eleven in 1317 autopsies, and that Thym noted 5.3 per cent. primary in ninety-four tuberculous pericarditis cases, while Osler reports seven primary in 275.

Secondary inflammation of the pericardial sac by extension from neighboring structures also occurs, though rarely, as in exceptional cases of pneumonia, especially in children and alcoholics, simple pleurisy (rare), purulent myocarditis, aortic aneurism (rare), malignant endocarditis, from mediastinal glands, bones of the thorax, and even from the abdominal viscera.[49]

The chief cause of primary pericarditis is external trauma, as in Fischer's case [51] of a patient who was thrown forward, striking his chest against the steering wheel of an automobile, although the pericardium occasionally may be infected by injury from within, such as perforation of the subjacent œsophagus,[52] or rupture of the stomach, as in Osler's case [38] of malignancy. Many so-called idiopathic cases are doubtless tuberculous, and others spring from tonsillitis.[53] That this disease is sometimes evanescent is shown by the frequency with which evidence of long standing past inflammation is found at autopsy in the guise of trivial adhesions or "milk spots" [54] in unsuspected cases. Ewart [53] has studied latent and ephemeral effusions which failed to attract attention because their small bulk did not elicit pain or provide conspicuous physical signs.

Pneumococci, Koch's bacillus, Bacillus pyocyaneus, B. Welchi, and various other pyogenic cocci and bacilli have been isolated from cases of purulent pericarditis.

No age group, not even in fetal life, is exempt from the disease, but the greatest frequency is between the sixth and twenty-fifth years.[33] As might be expected from its relationship with other diseases, pericarditis affects children more frequently than adults, and males more often than females (five times as often in males after the fourteenth year).[33] Pneumonia is responsible for most cases of pericarditis, not only in the age group under four years, but of *purulent* pericarditis at any age.[47]

McCallum's brief description of the pathology of pericarditis is so clear that I can do no better than to quote liberally from his book, as follows [55]:

"Sometimes only a thin film of fibrin is exuded on the pericardial surfaces without effusion of fluid (dry pericarditis). In that case a loud creaking or rubbing sound is made by each movement of the heart. If, then, fluid appears in excess, the surfaces are held apart, and the sound is lost or cut short." When fibrin is present, "or even when the

fluid is pus-like, ... one may observe that, through motion of the heart, the fibrin is beaten into compact ridges which run, roughly speaking, in certain transverse and oblique lines, "like those left by the waves on a sandy beach at low tide." "The heart is given a very shaggy appearance by this process."

"If a very great deal of fluid be exuded into the pericardial cavity, the sac is gradually dilated and will accommodate a large amount—far more than could be forced into it suddenly." "There comes a time, however, when the heart is greatly embarrassed by this fluid because it can no longer expand properly to receive the blood."

If recovery ensues it is by the formation of chronic adhesions. Close inspection will reveal the presence of tubercles in cases of tuberculous infection, where the adhesions are apt to be unusually dense.

The physical signs of pericardial effusion depend upon disturbed anatom-

FIG. 4.—Case I, J. L. before operation.

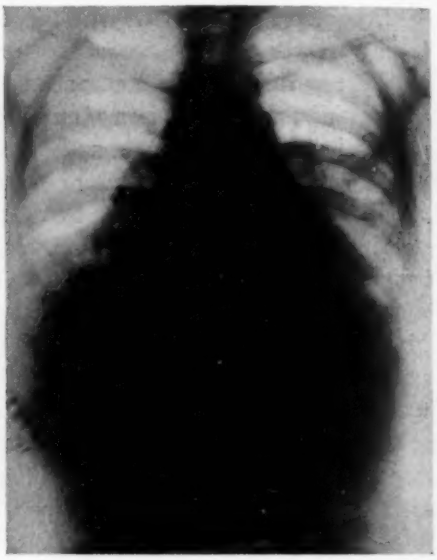

FIG. 5.—Case I, J. L. after operation.

ical and physiological relations resulting from the accumulation of fluid in the sac. Muffled heart sounds are characteristic, especially if these grow progressively more feeble following a gradually disappearing friction rub. This rub is presumed to vanish because the rough parietal and visceral layers of the sac whose frictions have generated it, have been separated by the intervening fluid, although the heart is usually found in contact with the anterior chest wall, even in massive effusions.[56] An accumulation of 750 c.c. may cause the disappearance of all traces of friction rub, even at the base and apex where frictions usually linger longest, while on the other hand, the rub might still be heard in the presence of as much as a litre.[57] These sounds occasionally are so elusive as to escape detection entirely, especially in the purulent variety.[47] In the typical case, just as a friction rub disappears simultaneously with the accumulation of fluid in the sac, so does it reappear again as the fluid diminishes.

Increase in the area of precordial percussion dulness with alterations in its shape are among the most trustworthy diagnostic signs, although too much emphasis is probably placed on the occurrence of the pyriform shape in this area.[49] Displacement of the dull area with change in posture was noted by Skoda, and is regarded by Shattuck as of some clinical value, but Robey fails to corroborate this.[49] Rotch,[58] a former Philadelphian, for whom the Rotch sign is named, refers to extension of cardiac dulness in the fourth and fifth interspaces on the right near the sternum, a corollary to the classic obtuse cardio-hepatic angle, the sign of W. Ebstein,[59] although Williamson's [56] experimental studies failed to verify the former.

Christian [60] found signs due to pulmonary compression in 73.5 per cent.

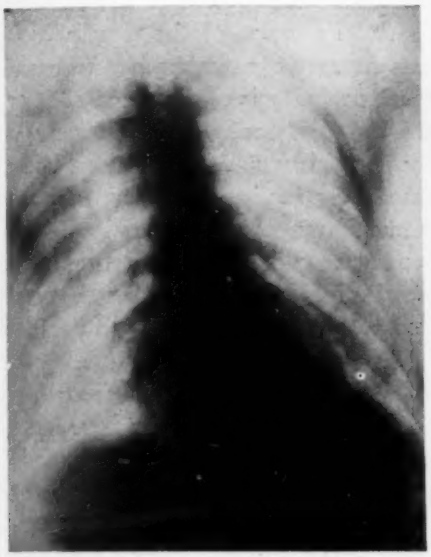

FIG. 6.—Case II, K. S. before operation.

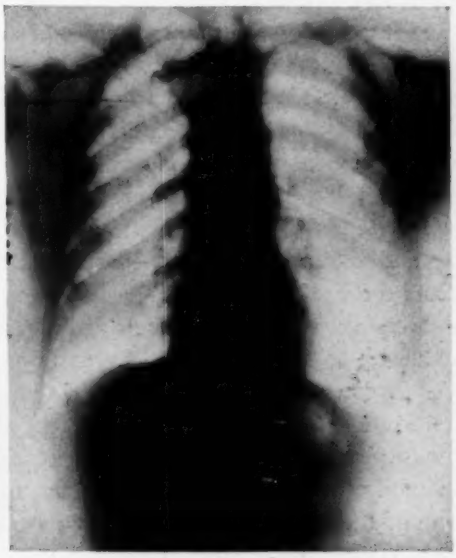

FIG. 7.—Case II, K. S. after operation.

of his cases. Dulness at the angle of the left scapula with bronchial breathing (Bamberger) and other signs simulating consolidation are often elicited; diminished respiratory expansion on the left also belongs to this group of compression signs. Ewart [61] described the invariable appearance, as a result of effusion into the pericardium, of "a patch of dulness of definite size, shape and situation at the posterior thoracic base, and its disappearance step by step with that of the fluid—this area is localized in the interval between the tenth and twelfth ribs close to the spine." It is sometimes possible to palpate the first rib on the left as far inward as the sternal articulation, in cases where the left clavicle has been raised from the underlying rib as a consequence of great respiratory activity in the upper part of the chest, embarrassed by a large effusion (Ewart's first rib sign).

Children are apt to show precordial bulging with enlargement of the entire left chest and prominence of the interspaces; while pressure exerted below through the diaphragm gives rise to swelling in the epigastrium. Downward

displacement of the liver, especially the left lobe, is regarded as the most constant early sign by Williamson,[56] who states that a 500 c.c. to 600 c.c. effusion causes a 2.5 cm. displacement.

Gradual diminution of the cardiac impulse may not always be present, for the heart often remains in contact with the anterior chest wall. On the other hand, the apex beat will be found to lie an undue distance medial to the left border of dulness, which is very sharply defined. Occasionally the apex beat, instead of disappearing, will extend as a wavy impulse through two or three interspaces.

A profusion of other signs have been described, but most of these are of more academic than of practical interest. To this class belongs the pulsus paradoxus, flushing of the face and neck with distention of the veins, and early accentuation of the pulmonic second sound.[49] Pulsation of the cervical vessels is sometimes as striking as that seen in aortic regurgitation (Stokes, Huchard). Fluctuation can never be elicited, probably because of the rigidity of the chest wall. Hoover's sign[57] is seen at times, limited to the lower left chest in extensive effusions, and if the effusion is purulent, the overlying chest wall may become œdematous. Some cases show a tender spot over the apex when this is pressed with the finger, and most patients seek relief by sitting up and leaning forward, a characteristic posture. Sibson[40] long ago emphasized the importance of suspecting pericardial effusion in those cases showing dulness extending above the third rib, as no other condition is said to present this sign so often.

Cardiac arrythmias probably owe their origin partly to reflexes from distention of the sac, for Heitler[62] was able to induce irregularities in animals by mechanical and electrical stimulation of the pericardium; and Kuno[63] pointed out "the mechanical influence of fluid in the pericardium on the function of the heart." The effect of general toxemia, as well as of local myocarditis, should not be overlooked as contributing to the probable cause of arrythmias, as brought out by the electro-cardiographic studies of Yager.[64]

This leads naturally to a consideration of the rôle played by instruments of precision in the diagnosis of purulent pericarditis. The use of these is subject to the same limitations as a good clinician's five senses in the diagnosis of this difficult disease. The very multiformity of the pathognomonic signs and symptoms should arouse one's suspicions of the difficulties to be expected in diagnosis, and the electro-cardiograph, X-ray, and polysphygmograph, are not exempt from the infallability of purely human methods. Taussig[66] (1914) pointed out the inspiratory exaggeration of the dicrotic notch seen in polysphygmograms, but there is nothing specific about the electro-cardiographic tracing of a case of purulent pericarditis[64] (at least nothing of this nature has as yet been discovered as far as I am aware), although such tracings may show secondary effects due to pressure toxemia and involvement of the heart muscle.

Typical röntgenograms, like typical physical signs, are easily diagnosed, but the typical cases are rare. Standard text-books on X-ray diagnosis

describe the findings somewhat as follows: They point out that the water-bottle-shaped shadow shifting with change of position of the patient is seen in no other condition except pericardial effusion. Obliteration of the normal heart shadow with widening of its base is also suggestive. Lateral views show a change in shape of the triangle formed by the posterior border of the heart, the diaphragm, and the spine, the space behind the so-called "pericardial ligament" being obliterated in most cases. Faintness or absence of pulsation may be brought out by fluoroscopic examination. These signs, of course, are not always quite satisfactorily interpretable, but the main difficulty is a clinical one and lies in the actual performance of the examination necessary for a good view. As a rule, when we rely upon the X-ray for clinching the diagnosis, the patient is too sick to be able to coöperate; nor indeed, would it be justifiable in most instances to subject him to the necessary manipulations for either a fluoroscopic examination or for securing plates with a lateral view. Furthermore, the character of the fluid cannot be determined by X-ray.

The symptoms of this disease are legion, and in my opinion relatively unimportant because they are so apt to be misleading. The diagnosis must rest, not so much on symptoms, as on physical signs. Pain is not often present, but authors present widely different views on this point. Capps,[67] in a recent experimental and clinical study, concludes that the presence of pain with pericarditis usually indicates the involvement of tissues outside the pericardium, especially the pleura. Upper abdominal pain may have its explanation in the liver displacement noted previously, though its occurrence is scarcely to be wondered at, considering the proximity of the diaphragm and structures beneath it to the pericardium. Fussell and Kay [68] have pointed out the occasional possibility of confusing appendicitis and pericarditis and offer a possible explanation. More frequently, perhaps, than actual pain, patients suffer from a sense of percordial oppression, and tenderness over this region of the chest has already been noted. Piersol, in his anatomy, suggests that this occurs because of the connection between the upper intercostal nerves and the ganglia and nerves of the intercostal plexus.

Dyspnœa is usually quite marked, and there may be other symptoms referable to pressure on neighboring structures from distention of the sac, as dysphagia, aphonia, cough, and pupillary changes similar to those seen in aneurism. Irritation of the phrenic nerve may cause hiccough, paroxysmal eructations, or vomiting.[69]

The general symptoms of fever, rigor, etc., need scarcely be discussed.

Diagnosis is made certain only by the finding of pus, either by exploratory puncture or by incision; but a probable diagnosis can be reached from a careful consideration of the etiology, the course of the fever, the cardiac muscle symptoms, poor general condition, precordial œdema, with high leucocyte count,[29] together with the help of the X-ray. Possibly the chief point in the diagnosis is to suspect the occurrence of purulent pericarditis in all febrile conditions, and to attempt to rule out the disease by failing to elicit any of its

signs. Only by persistent alertness in this respect can a clinician diminish this fruitful source of most embarrassing surprises at the autopsy table.[33]

The treatment of purulent pericarditis is drainage. Whether this should be accomplished by means of multiple punctures (10.4 per cent. cures), intercostal incision (37 per cent. cures), or wide exposure (56.6 per cent. cures) is not a matter of choice to the surgeon.[33] In the face of such statistics a conscientious man is compelled to resort to wide exposure. We will therefore proceed to a discussion of the operative surgery of suppurative pericarditis.

It will be unnecessary to review the anatomy of the field under con-

FIG. 8.—Case III, R. C. before operation.

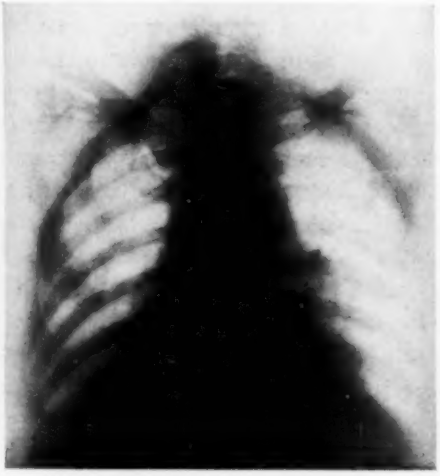

FIG. 9.—Case III, R. C. after operation.

sideration, except insofar as certain points have a practical bearing on the operation.

The accompanying figure (Fig. 1) shows the pericardium with its relations in sufficient detail. Recall that the sac lies in direct contact with the chest wall below the lowest segment of the body of the sternum, and in front of the fifth and sixth costal cartilages, and a portion of the seventh. Allowing for variations, the projection of its lower limits forms a plane inclined downward toward the left, passing through the middle of the xyphoid process. It terminates 5 or 6 cm. from the sternal margin on the left, and its extent from the right border of the sternum is 2 cm.[33] Any plan of operation designed to drain the sac must be influenced by these relations of its diaphragmatic portion, as well as by the position of the overlapping anterior margins of the pleuræ (Fig. 2). While normally the anterior margin of the left pleura lies quite close enough to the sternum to render itself liable to accidental wounding during an operation here,[70] its wide variation in position makes this danger even greater, despite the fact that the pleura is reputed to move outward under the influence of a distending pericardium, or, in other instances, is said to be obliterated in the danger zone by inflammatory agglutination of its surfaces.[30]

In view of the above facts, it is advisable to make the incision for drainage to the left of the sternum as low down as possible, for two reasons, first, because the lowermost point of the pericardium lies toward the left, and second, because the sac is more likely to be uncovered by the overlapping pleura on this side.

Many operations have been devised in accordance with these principles. Kocher,[71] as well as Voinitsch,[72] resected the sixth costal cartilage, and also the two above in some cases (Fig. 3). Delorme [25] resected the fifth and sixth costal cartilages. Removal of part of the sternum together with the attached

FIG. 10.—Case IV, M. G. before operation.

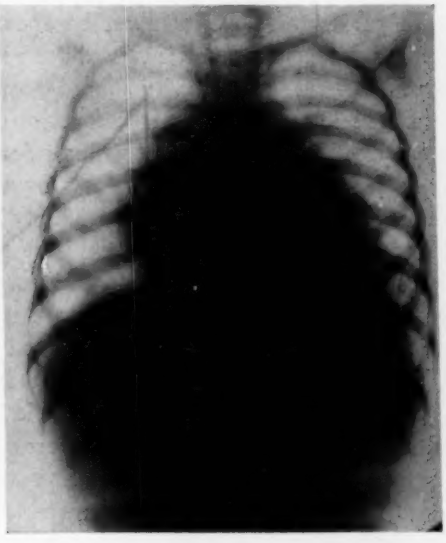

FIG. 11.—Case IV, M. G. after operation.

sixth and seventh cartilages was the method adopted by Voinitsch [72] and Rehn [73]; a trap-door skin flap resection of the seventh cartilage was made by Mintz,[74] and the costoxyphoid angle approach through Larrey's space [75] has also been advised. The epigastric route through the diaphragm from below (Allingham) [76] can scarcely be recommended for drainage of purulent discharges (Coutts and Rowlands [77]). Pool [30] uses an S-shaped incision in the soft parts to resect the seventh, sixth and fifth costal cartilages. He points out that incision in the pericardium should be vertical to avoid striking the pleura; and that wide exposure is necessary to secure dependent drainage and to guard against the danger of encapsulation of the pus. I have found excision of the fifth and sixth costal cartilages alone to be sufficient in my own cases.

Most authorities agree that local anæsthesia is indicated. In their order of appearances, the structures met with as the incision is made are skin, fascia, the pectoralis major muscle, external intercostal membrane, cartilage and internal intercostal membrane. The internal mammary artery is either drawn outward or cut between ligatures, after which the M. Triangularis

Sterni is seen. On opening this the pleura will be exposed if it is in the field. Writers recommend that it should be pushed outward, although the experience of Dr. John Klopp at the autopsy table leads me to believe that this is quite difficult, as he has found the pleural margins and pericardium to be quite adherent and scarcely separable without damaging one or the other. Fortunately I have not encountered the pleura in my series of operations.

The next structure to appear is the pericardium. Before handling this in any way, it should be anæsthetized locally, as dangerous reflexes are sometimes set up by stimulation of the pericardium.[62, 67, 69] The pericardium is then incised vertically, using the same technic as is commonly employed in opening the peritoneum. Care must be exercised to prevent rapid gushing forth of pus, for the structures involved are very sensitive to pressure changes. Exploration of the entire cavity should be performed gently with the finger, as loculated collections are apt to be overlooked otherwise. In one of my cases I was surprised to find a second welling forth of pus from behind the heart after I had just finished mopping up what appeared to be the entire contents of the sac. While the heart is surprisingly tolerant to foreign bodies, and although some operators have used them with success, nevertheless it would appear that stiff rubber drainage tubes should not be employed. The well known tendency of these drainage wounds to close too early necessitates the employment of some sort of drainage material, and because of its pliability, I have found "rubber tissue" quite satisfactory. This should be carried up behind the heart.

Pool recommends irrigation with Dakin's solution, post-operatively, but other authorities [33] advise only normal saline solution, if any irrigant at all is employed. I have not used either in my own practice. Posture will aid materially in securing proper drainage. The importance of care in dressing to prevent secondary infection is paramount.

I shall not discuss the general measures in the treatment, except to say that the use of Smalls serum [78] against the streptococcus of rheumatic fever might prove of value in rheumatic cases, although its originator makes no such claim for it.

Cases of chronic suppuration may require subsequent extirpation of the sac, and should post-infectious adhesions develop, cardiolysis may be of benefit later. This whole question, however, of end-results is one in need of detailed study.

Case I in my series illustrates the great difficulty in diagnosis. Operation seemed quite obviously necessary in this instance, yet we found at operation that we had been mistaken in the diagnosis and that we were dealing with a dilated heart. Six months after the patient's discharge from the hospital he was quite ill, with evidence of marked cardiac decompensation and a fatal prognosis was given.

The frequency with which empyema is associated with suppurative pericarditis cannot fail to strike one. This combination is abundantly illustrated in the series of cases appended, including one fatal case of my own (R. C.). Norris and Landis [57] point out the frequency with which pericarditis occurs

secondary to streptococcic empyema, and this may account for some cases. Others, I have little doubt, are due to secondary infections of the pleura at operation, as the separation of the latter from the pericardium is quite difficult judging from observations at the autopsy table.

CASE REPORTS

CASE I.—J. L., white, male, age eighteen years, admitted to the Episcopal Hospital, May 13, 1927, service of Dr. James Kay.

Chief Complaint.—Dyspnœa, substernal pain, and painful joints.

History of Present Illness.—This young man was admitted to the hospital with a history of having been in perfect health until three weeks before admission. At that time, while riding in a street car, he noticed when he arose from his seat that both knees and ankles were stiff, but he went about his day's work as usual without further difficulty. That same evening, however, he was seized with a sudden, dull aching pain over the entire sternum, occurring simultaneously with dyspnœa. Later that night he had definite chills followed by a fever (Temperature 101° F.) and he became so ill that he had to go to bed, where he remained until shortly before he was discharged from the hospital. The next day all of the above symptoms remained, but in addition he experienced very severe pain in both knees, and in the ankles, these joints becoming tender, red, hot and swollen; and continued so for one week. Subsequently he had dull aching pains, much less severe, in both shoulders, the wrists and elbows, but these were fleeting in character. The dyspnœa and substernal pain diminished somewhat as the joint symptoms disappeared, but did not absolutely cease. No respiratory, gastro-intestinal nor genito-urinary symptoms.

Past Medical History.—He does not recall the diseases of childhood, but states that he never had diphtheria, scarlatina or typhoid fever. Three years previously he had an acute febrile attack, accompanied by pain similar to the present, but confined to the knees and ankles and which kept him in bed for two weeks. Following this he had a tonsillectomy and adenoidectomy performed, and has had no similar attacks until the present. He never had chorœa. He denies and gives no direct evidence of venereal infection, and has never had any cardiac, respiratory, genito-urinary nor gastro-intestinal symptoms. His weight has been stationary. He has never had any operations, other than mentioned above, and no severe injuries.

Family History.—Has no bearing on the case.

Social History.—The patient was born and raised in Philadelphia, where he is an average factory worker in a Kensington textile mill. He denies the use of alcohol and tobacco, and has regular hours for sleep and meals. His living conditions are good for those of a man in his station of life.

Physical Examination.—May 13, 1927. The patient was an anemic looking young white adult, sitting up in bed, with body bent forward, evidently in great respiratory distress.

The scalp, ears, nose and face were normal. No petechiæ, hæmorrhages, œdema, nor any discoloration were found about the eyes, and the pupils were normal in all respects. There was no evidence of pyorrhœa, but several teeth were carious. Tonsillar fossæ were empty and the throat clean.

The thorax was found to be of the long narrow type, and the respiratory rate rapid (31 per minute), and shallow. No bulging of the interspaces was seen and there was no asymmetry. Percussion note, voice sounds, vocal fremitus and breath sounds were normal except in the lower third of the left chest in the mid-axillary line, where the classic signs of fluid were elicited, as well as similar signs in the lowermost 5 cm. of the right chest posteriorly. The heart rate was seventy-four per minute. The apex beat was seen and felt in the fifth interspace 10 cm. to the left of the mid-sternal line, measured circumferentially, which corresponds to the mammary line. The right border lay 3.5 cm. from the mid-sternal line. Heart sounds were distant, but a friction rub was not detected, although

a systolic apical murmur and a double aortic were heard. The abdomen and extremities presented nothing of importance.

Owing to the size and shape of the area of precordial dulness, a tentative diagnosis of pericardial effusion was made and this was confirmed by an X-ray examination performed by Dr. Ralph S. Bromer. So certain were all concerned that this boy was suffering from purulent pericarditis that operation was performed without delay under local anæsthesia (1 per cent. novocaine) by Dr. E. G. Alexander. The incision, 10 cm. long, was made along the left border of the sternum, resecting about 5 cm. of the fifth and sixth costal cartilages. The M. triangularis sterni was then divided, and the pericardial sac anæsthetized and opened in a longitudinal direction. No fluid was found, but a tremendously enlarged heart was noted as the cause of the mistake in diagnosis. The wound was then closed in layers without drainage.

The boy's post-operative course was like that of the average acute rheumatic fever case and he left the hospital in one month with a normal temperature and no joint symptoms, but with a "decompensated" heart. Six months later he was found to be in very bad condition, with marked anasarca, dyspnœa and cyanosis, and a grave prognosis was given.

Case II.—K. S., white, male, age twenty-five years, admitted to the Episcopal Hospital, November 18, 1926, service of Dr. Ross V. Patterson.

The onset occurred five days previously and was sudden, being manifested by pain in the upper left chest, followed by a chill and high fever. Cough and rusty sputum then followed, and finally the patient became delirious. He was so ill from the very first that he had to take to his bed and remain there.

About one year previously he is said to have suffered from an attack of acute lobar pneumonia, since which time his health has remained good.

Physical examination revealed typical signs of lobar pneumonia in the right upper lobe; there was a fever of 103.8° F. The heart was enlarged (apex beat in the sixth interspace 3 cm. external to the mid-clavicular line) and its sounds were described as being somewhat distant, but no adventitious sounds were noted, nor was there anything which might lead to a suspicion of pericarditis. A diagnosis of acute upper right lobar pneumonia was made.

The day after admission the patient's temperature dropped from 104° F. to 99° F., and because of the general improvement it was surmised that the sudden fall represented a crisis. The next day, however, the temperature had risen once more to 103° F. and the respirations remained rapid (thirty-four per minute). and consequently empyema was sought for but not found. On November 23, 1926, Dr. Ross V. Patterson made the following note, in part: "Heart—impulse slight or absent; the area of deep dulness encroaches upon the superficial and Traube's space is obliterated. An area of dulness replaces the cardio-hepatic angle. Heart sounds distant. Impression—pericarditis with purulent effusion."

The above diagnosis of effusion was confirmed by X-ray, and pericardiotomy was performed the following day by Dr. E. G. Alexander. Under local (1 per cent. novocaine solution) anæsthesia, an incision was made along the left border of the sternum about 10 cm. long, with its centre over the fifth interspace. Through this incision the costal cartilages of the fifth and sixth ribs were excised for about 5 cm. peripherally to the costo-chondral junctions and the M. triangularis sterni separated. The pericardium was then infiltrated with novocaine and incised in a longitudinal direction parallel to the skin incision, whereupon about 100 c.c. of turbid fluid was allowed to escape. This proved to be pus, but no organisms were isolated. The recovery was uneventful, and the man, when last interviewed (December 23, 1927) was found to be in excellent physical condition, presenting no evidence of cardiac disease. He works as an electrician every day and has no physical incapacity whatsoever.

Case III.—R. C., white, male, age forty-four years, admitted to the Episcopal Hospital, February 18, 1926, service of Dr. John B. Carson.

Nineteen days previously this man was stricken with acute lobar pneumonia, and was treated for it at home by his family physician until the latter advised the family that hospitalization was necessary because of the probable development of empyema.

Physical examination on the day of admission revealed a very sick patient, presenting a "septic appearance". He showed signs of fluid at both pulmonary bases posteriorly, more marked on the left. The exact position of the apex beat could not be determined, as it extended as a wavy impulse throughout the precordial interspaces; there was an obtuse cardio-hepatic angle as well as extension of the cardiac dulness toward the left and upward as high as the second interspace. The sounds were muffled, but regular, and there were no adventitious sounds, shocks nor thrills. The white blood count was 24,320 per cu. mm., polymorphonuclear leucocytes predominating. The patient's fever proved to be of the septic type, ranging between 98° F. and 103° F. Dr. Ralph Bromer examined the patient röntgenologically and reported a typical shadow of pericardial effusion. On the basis of these findings a diagnosis of suppurative pericarditis was made and confirmed at operation, performed February 18, 1926, by Dr. E. G. Alexander.

Under local anæsthesia (1 per cent. novocaine) an incision was made and carried along the left border of the sternum a distance of 12 cm., with its centre over the sixth costo-chondral junction, exposing the latter. About 6 cm. of the fifth and sixth cartilages were then removed and the underlying triangularis sterni divided, exposing the tense pericardium heaving beneath it. A small needle was then inserted into the sac and about 20 c.c. of thin, sanguino-purulent fluid withdrawn into a syringe. The pericardium was then infiltrated with 1 per cent. novocaine and incised longitudinally, whereupon 60 c.c. of a similar fluid was allowed to escape slowly. An attempt to raise the pericardium between hæmostats was unsuccessful because the latter could not be made to pick up the tense sac. The aspirated fluid contained pus cells, but no organisms were found in the smear or culture. A No. 16 soft rubber catheter was then introduced behind the heart and through it 340 c.c. more of a similar fluid was withdrawn through a syringe. This catheter was then allowed to remain *in situ*, being anchored by silkworm gut sutures to the skin. Two small strips of iodoform gauze were placed in the incision on either side of the catheter and the wound was then closed around these by through and through silkworm gut sutures (interrupted). The patient was placed in a warm bed and returned to his room in fair condition, having withstood the operation quite well. He was given morphine sulphate gr. 1/6, and atropine sulphate gr. 1/150 by hypodermic injection just before operation and again several hours later; and in addition took tincture of digitalis (B. and W.) Mxx, q.4.h., alternating with spiritus frumenti f℥iss q.4.h.

Directly after the operation a second röntgenogram of the heart was taken by Doctor Bromer, who noted a marked decrease in the density of the shadow, which was evidently thrown by the pericardial sac, as within it could be distinguished the outline of the heart. The catheter could be seen in the film.

February 19, 1926.—The patient's temperature, which was 102° F. before operation fell to 98° F., but his condition remained only fair. The tube and gauze were removed from the wound. Signs of fluid now present in the lower two-thirds of the left chest. Dyspnœa marked and cyanosis set in.

February 20, 1926.—X-ray of the chest by Dr. Ralph Bromer confirmed the presence of fluid in the left chest and also showed a small amount in the right chest. The pericardium was thought to contain fluid as yet undrained. The temperature again arose to 102° F. after having been normal directly after the pericardiotomy. The left chest was then aspirated through the seventh intespace in the mid-scapular line and 90 c.c. of thick greenish flakey pus obtained.

February 21, 1926.—Thoracotomy without rib resection performed at the same point as aspiration the day before, and a rubber tube placed in for drainage; similar pus was obtained. This was found to contain a diplococcus pneumoniæ, not typed.

February 23, 1926.—As the drainage from the pericardial wound had stopped, this was dilated by spreading with the open jaws of a hæmostat, and a rubber tube was inserted. White blood count 27,200. Polymorphonuclear leucocytes 82 per cent.

March 1, 1926.—Several attempts were made since the preceding note to facilitate drainage from the pleura and pericardium, but these were not successful. Tube then removed from the pericardium. The general condition became worse and the physical signs remained unchanged.

March 4, 1926.—The pericardial wound has practically healed. Tube removed from the chest. No drainage. Condition poor. Temperature has been of the septic type, its limits ranging between 98° F. and 103° F. Nausea and some vomiting at times.

March 12, 1926.—Gradually progressing weakness, otherwise no change.

March 15, 1926.—The old pleural wound was opened again and a catheter inserted. No drainage obtained, nor did thoracentesis performed in several locations yield any pus.

March 17, 1926.—X-ray by Dr. Ralph Bromer shows collection of pus in the posterior mediastinum. Other collections have diminished.

April 1, 1926.—The patient's condition grew progressively worse since the last note and death ensued this morning.

Autopsy Findings.—Acute suppurative pericarditis; acute empyema thoracis, left; acute lobar pneumonia, right, with marked bilateral pulmonary congestion. No organisms were isolated from the pericardium, but the diplococcus pneumoniæ (type not determined) and staphylococcus aureus were obtained from the left pleura by culture, both from the specimens at previous operation and from the autopsy.

Case IV.—M. G., white, female, age six years, admitted June 17, 1927, to the Abington Memorial Hospital into the service of Dr. Sumner Cross, having been referred there by her family physician, Dr. E. E. Sprenkel, with a provisional diagnosis of pericardial effusion.

Chief Complaint.—Dyspnœa.

History of Present Illness.—The child had been well until seven days before her admission, when she developed a frontal headache and sore throat, followed by fever (temperature 104° F.) and rapid pulse (160 per minute). Three days before admission she began to show a septic type of temperature, and in spite of treatment she did not improve. She was admitted to the hospital with a temperature of 101° F. (mouth), respiratory rate 60, and a pulse rate of 150 per minute.

She has had dyspnœa since the onset but no œdema or cardiac pain. No other symptoms of note were elicited from the mother's history.

Past Medical History.—She never had rheumatic fever nor chorœa, and only one attack of tonsillitis. She has had no operations or severe injuries.

Family History.—Irrelevant.

Social History.—Living conditions are good.

Physical Examination.—Reveals a very alert, pale, dyspnœic, white female [illegible] years. The head, including the ears, eyes, nose and face show nothing abnormal. The tonsils are large and give evidence of acute inflammation; cyanosis of the lips is quite marked. No abnormal pulsations, rigidity or adenopathy were noted in the neck, and examination of the lungs reveals nothing of note.

Heart.—The apex beat was seen and felt in the sixth interspace 2.5 cm. lateral to the mid-clavicular line on the left. The impulse was quite diffuse. On percussion the left border of the heart was 8 cm. to the left of the mid-sternal line and the right 4 cm. to the right in the fourth interspace. No shocks, thrills, nor precordial bulging were present, and the rhythm was normal. The rate was 150 per minute; sounds of the heart were of good quality and normal in intensity, but at the apex were both a systolic and a diastolic murmur, the former of which was transmitted to the left axilla. The pulmonic second sound was of greater intensity than the second aortic.

Abdomen.—Liver dulness extended from the fifth rib to 4 cm. below the right costal border in the mid-clavicular line, and the liver was tender.

Extremities.—No abnormalities noted, except pulmonary anthropathy and cyanosis of the nail beds.

Genitalia, rectum and spine were normal.

X-ray by Dr. Donald Gulick showed an increase in the area of heart shadow not suggestive of pericardial effusion.

June 20, 1927.—The patient had a very uncomfortable night, suffering from dyspnœa and cough. X-ray shows no change.

June 22, 1927.—Paroxysmal attacks of coughing and dyspnœa occurred, during which pallor and cyanosis increased, and the child perspired freely. The sputum was blood tinged.

June 23, 1927.—X-ray showed a definite increase in the size of the heart shadow, which now presented a triangular shadow and was very suggestive of pericardial effusion.

Pericardiotomy was accordingly performed by Dr. E. G. Alexander, under local (1 per cent. novocaine) anæsthesia. An incision 8 cm. long with its centre over the fifth interspace, was carried down the left border of the sternum, over the fifth and sixth costo-chondral junctions. About 4 cm. of each of these cartilages were excised and the triangularis sterni fibres separated, bringing the pulsing pericardial sac into view. The latter was then infiltrated with 1 per cent. novocaine solution and incised carefully between hemostats in a longitudinal direction. About 50 c.c. of turbid fluid was permitted to escape slowly. This proved sterile on culture, but contained pus cells and erythrocytes in abundance; no organisms were found in the smear. The wound was then closed at its upper end only, allowing the lowermost portion to remain open for drainage, and sterile dressings were applied. The patient withstood the operation well and was returned to her room in no worse condition than when she left it. Recovery was rapid and uneventful, and at the last report, eight months later, the child was in good health and able to take dancing lessons.

CASES FROM THE LITERATURE SINCE 1921

No. 1, 1926.—Death. Avierinos, F., and Turries, J.: Arch. de Malad. du Coeur, 1926, vol. xix, pp. 670–675.

Italian laborer, forty-four years of age, admitted to hospital with ill-defined febrile affection, complaining of pain in right hypochondrium and dyspnœa of eighteen days' duration. The onset occurred with severe precordial pain, radiating only to the upper left arm. The right hypochondriac pain being present only the past four days. Vertigo, sweating and fever have also been prominent.

Physical Examination.—Signs of left pleural effusion with muco-purulent expectoration for the past twenty-four hours. Examination of the heart showed precordial dulness increased to right and left. After a diagnostic exploratory puncture, pericardiotomy was performed. At operation very fetid, gassy pus escaped, and a drain was inserted. Fifty cub[illegible]metres of anti-gangrene serum polyvalent were then administered intra-muscularly and the wound closed. Death two hours later.

Autopsy.—Showed fistulous connection between pericardium and left bronchus, through which the patient was able to expectorate pus.

No. 2.—(Not reported by Pool, 1921). Adyne-Curran, W. J. P., Jr.: Roy. Army Med. Corps, London, 1918, vol. xxx, p. 599. Gunshot wound in the precordium; pyopericardium with gas infection.

O. W., age twenty-two years, admitted to the hospital October 9, 1916, with a wound, of entrance only, over the ninth rib, in the left posterior axillary line, having been wounded September 27, 1916.

Physical Examination on October 14, 1916, showed normal precordial dulness, which on October 15, 1916, changed to complete obliteration of the precordial dull area. X-ray showed distention of the pericardial sac, and a diagnostic needling was decided upon, using 2 per cent. novocaine for local anæsthesia. Gas was found to escape through the canula, thereby tending to confirm the previous clinical diagnosis of gas bacillus pericarditis. Pericardiotomy was then performed under local anæsthesia, first excising the sixth costal

cartilage, whereby eight ounces of foul yellow pus was allowed to escape from the sac. A rubber drain was placed and the wound closed loosely about this. Convalescence was complicated by the development of pleural effusion and also phlebitis (arm). It was necessary to enlarge the draining wound under ether about twelve days post-operatively. The patient was then discharged to England in good condition February 2, 1917, and has been reported as improving since then, though his wound was still draining.

No. 3.—(Recovery). Bransfield, J. W.: ANNALS OF SURGERY, 1924, vol. lxxix, p. 293. Pericardiotomy for suppurative pericarditis.

Male, age eighteen years, complaining of pain in the left chest and dyspnœa, with a history of having run a scissors blade through the left chest two days previously. Examination showed abscess pointing over the ninth rib in the left nipple line, but incision of this failed to give expected relief of dyspnœa after evacuation of two ounces of pus. X-ray then revealed pericardial effusion confirmatory to physical signs of same. Eight days after admission pericardiotomy performed under local anæsthesia (resection of fourth costal cartilage) and one ounce fluid obtained (Staphylococcus aureus). Fluoroscopy performed at once showed that there was no doubt about distention of the pericardium, so that the patient was returned to the operating room and under general anæsthesia had resection of the fifth and sixth costal cartilages. Half pint of fluid escaped this time (Staphylococcus aureus).

Post-operative treatment consisted in daily irrigations with normal saline solution for two weeks, with drainage, after which Dakin's oil was used. By the fourth week the temperature was normal, and the patient was out of bed the fifth week. Examinations at three week intervals for four months subsequently failed to reveal any disturbance of the heart, and the X-rays were normal.

No. 4, 1924.—Death. Despard, D. L., reports the following case in discussing the above paper by Bransfield:

Man with a history of bronchitis or broncho-pneumonia past three months. X-ray revealed a dilated pericardium. Local anæsthesia. Incisions along the left border of the sternum between the fourth and seventh costal cartilages. Dakin's tubes were inserted. Two or three days later the patient's temperature rose and death ensued.

Autopsy Findings.—Chronic suppurative pericarditis; tuberculous adenitis, peribronchial.

No. 5, 1924.—Death. Dufour, H. and Baruk, H.: Bull, et Mem. Soc. Med. d'Hop de Paris, 1924, vol. xlviii (3 S.), p. 744.

A patient showing septicæmia for fifteen days, followed by signs of pericardial effusion. Past twenty-four hours developed cough and fetid expectoration. Pericardiotomy performed seventeenth day of illness followed by death. Autopsy showed purulent pericardial effusion which had existed side by side with gangrenous infection of both lungs. The authors present evidence for their opinion that this represents a case of blood stream infection attacking both pericardium and lung.

No. 6, 1924.—(Recovery). Hall, A. J., and Townrow, V.: Brit. M. J., 1924, vol. ii, p. 1148. Purulent pneumococcic pericarditis; pericardiotomy; recovery.

Male, age seventeen years, developed an acute pain in the left chest anteriorly. Three days later he became very ill and signs of pericarditis were noted. Temperature 102.8, pulse 120, respiration 40. Increase in the area of cardiac dulness, with the apex beat an undue distance medial to the left edge of dulness, together with gradually disappearing friction rub. Three hundred cubic centimetres of sero-fibrinous straw-colored fluid was withdrawn through a needle placed in the fifth interspace 4.5 cm. to the left of the sternum and pneumococci were isolated from this. On the ninth day a second paracentesis was performed and 200 c.c. of a similar fluid withdrawn. Later, under local anæsthesia, pericardiotomy was performed, excising 2.5 cm. of the fifth left costal cartilage and inserting a drainage tube behind the heart. Later, a left pyothorax was drained. The patient recovered. The authors consider paracentesis as of value in tiding patients over an unfavorable condition so that operation may follow with less risk.

No. 7, 1921.—(Recovery). Hedblom, C. A.: Surg. Clin. N. Am., 1921, vol. 1, p. 1411. Primary tuberculous pericarditis.

Male, age thirty-six years. Onset occurred eleven months previously (May 1, 1921) with fever, sore throat and loss of weight.

This was followed by an attack of bilateral phlebitis (legs) accompanied by night sweats, chest pain, and chronic non-productive cough. Later dyspnœa and cyanosis developed.

Physical examination showed diminished expansion on the left side of the thorax, obliteration of the cardio-hepatic angle, and distant heart sounds. No murmurs. No arrhythmias noted, but the vessels of the neck became suffused when the patient occupied the recumbent posture. Blood pressure 108–88 mm. mercury. X-ray showed a large cardiac shadow. A total of 2500 c.c. of fluid were removed by tapping the pericardium, the first of these being clear, but the last purulent. Pericardiotomy was then performed with liberation of 2000 c.c. of fluid, and the wound was closed without drainage. The fluid gave a smear positive for Koch's bacilli, but the guinea-pig inoculation was negative. Two months later, a recurrence set in, as noted by symptoms and X-ray. Pericardiotomy was again performed and 2000 c.c. of fluid removed. The wound of the soft parts was closed without drainage, but this time the pericardium was left open. The discharge gradually became thicker, and finally, four months after admission, the patient was discharged in poor condition.

Case 8, 1926.—(Death). Leys, D.: Lancet, vol. ii, 1926, p. 1004. A peculiar case of pneumopyopericardium.

Male, age eleven years, admitted to the hospital, March 9, 1925, complaining of pain in the left shoulder and vomiting, both of one week's duration. Physical examination showed equivocal signs of pericardial effusion. On March fifteenth the patient made a striking change for the worse, and an X-ray showed gas and fluid in the pericardium. Operation was then performed, excising portions of the fourth and fifth ribs through a horizontal incision in the left nipple line, exposing and then opening the pericardium. A large amount of very foul pus escaped which on culture proved to contain a hæmolytic streptococcus, with B. mucosis capsulatis and a gas forming anaërobe. The boy survived the operation for one week, discharging a large amount of pus throughout.

Autopsy showed a sinus connecting the pericardium with an œsophageal diverticulum to which latter a caseous tracheal lymph gland was adherent.

No. 9, 1925.—(Recovery). Wood, A. C., and Bradley, W. N.: Atlantic M. J., 1925, vol. xxvii, p. 436.

White male, age four years, nine months old, admitted April 8, 1923, with a history of having had rubeola three weeks previously, followed by fever, cough and pain in the abdomen and lumbar region. Physicians at the patient's home made a diagnosis of probable empyema following broncho-pneumonia, for the child became distinctly worse just before he was hospitalized, and showed signs which led to this diagnosis. X-ray April 9 showed a shadow in the left chest, which led to an exploratory puncture, April 12, 60 c.c. of serum was withdrawn through a needle in the seventh interspace posterior axillary line, and pus was obtained from a needle placed in the second interspace just outside the nipple line.

April 17, as the patient's condition failed to improve, despite the establishment of drainage five days previously, the exploratory needle was again inserted into the depths of the wound and this time drew pus from the pericardial sac, as it was found to swing simultaneously with the heart beat.

An X-ray showed probable pericardial effusion and operation was performed April 21.

Ether anæsthesia. Resection of 4 cm. of the third rib reveals a bulging tumefaction, the pus-distended pericardial sac. This was opened and 250 c.c. of yellow pus was evacuated. The sac was then irrigated with warm saline solution. No drainage tubes were inserted at operation but the wound was kept patent by divulsion and the sac irrigated with Dakin's solution.

April 25.—A drainage tube was inserted, to remain a few days.

May 3.—Practically no discharge. Condition good.

May 12.—Wound has been healed. Heart sounds, rhythm and dulness normal.

No. 10, 1924.—(Death). Brooks, R.: Lancet, 1924, vol. ii, pp. 319–20.

Male, age eleven years, admitted with acute osteomyelitis of the left femur, seven days' duration. Operated at once. Eight days later no sign of improvement, which led to examination of the chest and revealed the presence of pleural effusion, which was tapped. Turbid fluid obtained, sterile in forty-eight hours. Pus ten days later (Staphylococcus aureaus). Pericardiotomy. Death. Post-mortem: Abscess of myocardium and pus in pericardium.

No. 11, 1924.—(Recovery). Brooks, R.: Lancet, 1924, vol. ii, pp. 319–20.

Male, age twelve years, acute osteomyelitis of fibula of twenty-four hours' duration. Immediate operation. Fourteen days later amputation became necessary because his progress was poor. On the twenty-first day a metastatic abscess developed over the left humerus; seven days later a friction rub was noted, gradually disappearing subsequently. Cardiac dulness increased simultaneously; twelve hours later pericardiocentesis followed by pericardiotomy. A rubber drainage tube was left *in situ*. Staphylococcus aureus was isolated from the pus which came a few hours later. Recovery uneventful.

No. 12, 1924.—(Recovery). Brooke, R.: Lancet, 1924, vol. ii, pp. 319–20.

Male, age eleven years, developed acute osteomyelitis of the right tibia, for which he was operated upon; eight days later a friction rub was detected. On the twelfth day the pericardium was tapped and turbid fluid obtained (Staphylococcus aureus). Pericardiotomy. Recovery uneventful.

No. 13, 1923.—(Recovery). Gamberini, C.: Arch. Ital. di Cœur, 1923, vol. vi, p. 619.

Male, age seven years, presented evidence of suppurative pericarditis, confirmed by pericardiocentesis. Subsequent frequent multiple punctures were unsuccessful and pericardiotomy was performed with excellent result, except for slight thoracic deformity.

No. 14, 1921.—(Recovery). Rouvillois, H.: Bull. et Mem. Soc. de Chir. de Paris, 1921, vol. xlvii, p. 1117. Tuberculous pericarditis treated and cured by pericardiotomy without drainage.

No. 15, 1926.—(Recovery). Westerborn, A: Upsala Täkaref. Fork., 1926, vol. xxxi, pp. 609–622.

S. E., sixteen years of age, was admitted to the hospital, March 28, 1926, with a history of pain beneath the right nates and a fever. On admission his temperature was 40.3° C., and physical examination revealed the presence of a carbuncle beneath the right nates, and which was incised the following day. On the fifth day a pericardial friction rub was detected, and five days later there were signs of pericardial effusion, confirmed by X-ray. Yellowish pus containing staphylococci was removed on April 7 and again on April 17 and May 5. On May 8 a pericardiotomy with drainage was performed under local anæsthesia, using the left costo-xyphoid angle incision with resection of the sixth and seventh costal cartilages. During the operation the left pleura was wounded. Convalescence was complicated by pleural effusion, but on July 31 the man was discharged cured.

Nos. 17 and 18.—(Recovery). Bressot: Lyon Chir., 1925, vol. xxii, p. 747, reports two cases of tuberculous pericarditis treated by pericardiotomy.

No. 19, 1921.—(Recovery). Duguet: Bull. et Mem. Soc. de Chir. de Par., 1921, vol. xiv, p. 1111. A report of a case of tuberculous pericarditis treated successfully by pericardiotomy.

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PULMONARY ABSCESS—AN EXPERIMENTAL STUDY*

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The etiology of pulmonary abscess has been the topic of much recent discussion. One view in the mechanism of pulmonary abscess etiology is that infected emboli are lodged in the lung and produce abscesses. Cutler [1] and his co-workers produced experimentally such abscesses by injecting infected emboli into the jugular vein. In spite of these striking experimental results, clinical evidence would lead one to believe that pulmonary abscesses are commonly produced as a result of aspiration of infected materials into the lung. In a study of the effects of anæsthesia on aspiration, Lemon [2] found that aspiration of mucus and other substances occurs in the lung during the course of a general anæsthetic. When, however, the head of the animal was 28.75 cm. lower than the feet aspiration did not occur in his animals. In the discussion of Lemon's paper, Hedblom [3] called attention to the fact that "pulmonary infection in man following aspiration must depend largely upon the nature or the virulence of the infective organisms or both."

Myerson,[4] in a bronchoscopic study of one hundred cases undergoing tonsillectomy under light general anæsthesia, found that the abolition of the cough reflex is of great importance in aspiration. In seventy-eight out of 100 cases the cough reflex was abolished and in seventy-two out of the seventy-eight he noticed blood and mucus distal to the larynx. In twenty-two out of the 100 cases the cough reflex was not abolished. In only four out of this number he noticed blood and mucus below the larynx.

That the aspirated blood reaches the alveoli very readily is proven by the work of Corper.[5] He observed that under ether anæsthesia aspiration of fluids after instillation into the nose occurs readily in dogs and rabbits placed in the horizontal position. In the non-anæsthetized animal lying in a horizontal position, however, repeated nasal instillations did not cause aspiration. On the other hand, with the non-anæsthetized animal in the vertical posture the aspiration of fluids was easily attained in rabbits but less so in dogs, the fluid being found mainly in the lower lobes. Corper also found that particulate matter such as carbon particles are found heaped up at the points of bifurcation of the air passages with relatively little being retained in the alveoli. In another series of experiments he traced the aspirated fresh blood in the alveoli of rabbits as late as four weeks after the intratracheal injection. At the site of blood localization the presence of a distinctly palpable induration

* Read before the Chicago Tuberculosis Society, January 19, 1928.

was noticed. This was due to a proliferative pneumonitis occasioned by the presence of blood in the finer pulmonary subdivisions. The induration was found to persist longer than four weeks.

From the bacteriologic aspect the most fruitful research in pulmonary abscess has been the study of fusospirochetes. Withington [6] in 1898 advanced the theory that certain saprophytes were the cause of pulmonary suppuration. He quotes Babes who says "these saprophytes cannot of themselves produce gangrene but are inevitably associated with some other organism, generally the pyogenic coccus." The extensive studies of Pilot and Davis [7] and also of Kline [8] and his co-workers gives enough of evidence of proof that the group of organisms found in the mouth of patients with pyorrhœa alveolaris are more than harmless normal inhabitants of the mouth and very likely an etiologic factor in the production of pulmonary abscess. These organisms are known under the general name of fusospirochetes and include Vincent's spirochetes, fusiform bacilli, pyogenes, diphtheroids, and at times bacilli, particularly the bacillus influenzæ. David T. Smith [9] injected intratracheally bloody material obtained from about the teeth of patients suffering with moderately severe pyorrhœa. He obtained pulmonary abscesses in 20 per cent. of his animals. He used fifty mice, forty guinea pigs, five rabbits and three dogs. Smith recovered from the pus of these abscesses organisms which were morphologically identical with those recovered from pulmonary abscess in man. He was unable to produce abscesses in his three dogs. After repeated procedures we have been able to fill in this gap with our experimental work and produce pulmonary abscesses of variable frequency depending upon the conditions present. By perfecting our technic and simulating tonsillectomy conditions, as close as possible, we obtained abscesses in over 70 per cent. of our dogs.

EXPERIMENTS AND RESULTS

Sixty-seven intrabronchial injections of infected materials were performed. Abscesses were produced in twenty animals or 29.8 per cent. The highest incidence of abscess formation was noticed when fresh dog blood was mixed with sputum from a patient with a pulmonary abscess. In this series fourteen injections were performed and abscesses were found in ten dogs or 71.4 per cent. The sputum from the clinical and experimental abscesses showed the characteristic fusospirochete combination along with the pyogenic cocci, diphtheroids and Gram-negative bacilli.

Sputum from a clinical abscess was injected unmixed in seven dogs. In two out of these or 28.6 per cent. abscesses were obtained.

Variable combinations of infected materials were tried, namely: Abscess contents with small pieces of tonsil, pyorrhœa scrapings with pieces of teeth, pyorrhœa scrapings with tonsil tissue, and citrated tonsillectomy blood, plain citrated tonsillectomy blood, citrated blood combined with teeth, and gastric contents injected during an abdominal operation, and plain gastric contents. In addition to these, pure cultures of staphylococcus aureus suspended in

fresh blood and also of hæmolytic streptococcus in fresh blood were injected. It should be said in passing that it was impossible to produce any abscesses in the dogs that received only pure cultures of staphylococcus mixed with blood.

In a group of nine dogs we produced a frontal sinusitis by implanting into the sinus a cotton pledget saturated with sputum from clinical pulmonary abscess. In three out of the nine dogs or 33.3 per cent. we found pulmonary abscess.

When a foreign body was implanted into the lung parenchyma it was found to be well encapsulated by a thick wall of fibrous tissue, but there was no definite abscess at the site of implantation. Foreign bodies such as agar agar, pennies, navy beans, and salted peanuts were implanted in the lung.

The dogs that showed abscess formation died or were killed from one to one hundred seven days after the experiment. The abscesses varied in size from two millimetres to ten centimetres. In three dogs the lobe containing the abscess was partly or wholly gangrenous. In some cases the abscesses perforated into the pleura and caused a fatal pleurisy with effusion. Although the mediastinal lobe was involved in most cases, abscesses were found in all parts of the lung. In one case a large abscess was found in one of the tracheal glands just below the sternum at the level of the first two ribs.

SUMMARY

Aspiratory abscess can be produced in the dog if the cough reflex is controlled sufficiently long to allow the infected liquids to settle in the alveoli. The highest percentage of abscesses occurred in dogs which received fresh blood mixed with a sputum that contained a high degree of fusospirochetes mixed with pyogenes. Pyogenic organisms mixed with blood did not cause any abscesses in our animals. A lower percentage of abscesses has been produced by the injection of gastric contents, pyorrhœa scrapings, or combinations of the above mixed with small pieces of tonsils and teeth.

It has been argued that pulmonary abscesses of aspiratory origin are connected with the bronchus and that those of embolic origin are walled off and have no communication with the bronchus. In a dog that died seven days after the injection of sputum mixed with blood we found in the lower lobe an abscess the size of a hen's egg and on careful examination we could find no communication with the bronchus.

To show how important is the abolition of the cough reflex we shall mention the following incident. In one dog we injected blood mixed with gastric contents. While the cough reflex was still present we introduced a tooth through the bronchoscope and blew it in with compressed air. Immediately afterwards the opening of the bronchoscope was covered with the thumb. When the dog coughed the tooth was blown out with such a force that the root of the tooth pierced the thumb and caused an infection of the finger.

The following table will give a graphic picture of our experiments and results:

SUMMARY OF EXPERIMENTS

Procedure	Number of Dogs.	Number of Abscesses.	Per cent. of Abscesses.
Fresh dog blood plus abscess contents	14	10	71.4
Abscess contents	7	2	28.6
Abscess contents plus tonsil tissue	3	0	0.0
Pyorrhœa scrapings plus tooth	2	1	50.0
Pyorrhœa scrapings plus tonsil tissue—plus citrated blood	6	1	16.6
Citrated blood	5	2	40.0
Citrated blood plus tooth—plus abdominal operation	2	0	0.0
Citrated blood plus tooth—plus abdominal operation —plus gastric contents	3	0	0.0
Gastric contents	5	1	20.0
Staph. aureus plus fresh dog blood	10	0	0.0
Hæmolytic streptococcus plus fresh dog blood	1	0	0.0
Experimental sinusitis—chronic	9	3	33.3
Implantation of agar agar	4	0	0.0
Implantation of penny	1	0	0.0
Implantation of navy beans	6	0	0.0
Implantation of salted peanuts	3	0	0.0
Total	81	20	24.7

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VASOMOTOR AND REFLEX SEQUELÆ OF UNILATERAL CERVICAL AND LUMBAR RAMISECTOMY IN A CASE OF RAYNAUD'S DISEASE, WITH OBSERVATIONS ON TONUS

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The reflex changes ensuing upon sympathetic ramisectomy have for some years been under discussion among physiologists and surgeons. Many physiologists have been unwilling to admit that reflexes become altered following such procedures (see Forbes and his co-workers, 1926; Adrian, 1920; Cobb, 1925, etc.), while certain surgeons (Royle, 1926, 1927; Stewart, 1927, and others) have adduced strongly suggestive evidence that such changes do in fact occur. All are agreed, however, concerning the character of the vasomotor changes (see especially G. E. Brown, 1926; Adson, 1926; Adson and Brown, 1925; Davis and Kanavel, 1926). As the following case, which was studied with great care both before and after operation, seemed to throw light upon certain questions which are still unsettled, I felt that it was desirable to report it now rather than to await further collective evidence.

Case I.—*P. B. B. H. Surg. Nos. 27524, 28273, 28574. Chilblains in childhood; difficult first pregnancy with emotional disturbance, excessive lactation and profuse perspiration; onset of ischæmic symptoms in digits and toes after puerperium; pustule formation and gradual sloughing of terminal digits of index fingers for seventeen years; right radial periarterial "sympathectomy" with no relief; right-sided cervical and lumbar ramisectomy; relief of symptoms in lower extremity, reflex changes.*

Ruth M., an American housewife of forty-two, referred by Dr. C. L. Payzant of West Medford, Mass., was first admitted on October 29, 1926. She presented unmistakable symptoms of Raynaud's disease.

Clinical History (summarized from information obtained during three successive hospital entries).—There was no history of neurotic instability or of Raynaud's disease among her ancestors or in any member of the family. Patient had been married nineteen years, and had had three children with no miscarriages or stillbirths.

Onset of Present Illness.—Prior to her marriage the patient had always been a cheerful, even-tempered individual whose general health had been unusually good. Her habits were excellent and she had never smoked. There was nothing to suggest paroxysmal hæmoglobinuria. In childhood, however, her feet had been subject to chilblains, but for ten to twelve years before the onset of her present trouble she had not been so troubled. At seventeen she had had a running ear. Her present illness began four to five months after the birth of her first baby. The pregnancy had been uneventful and the patient was pleased over the prospect of having her first child. As her marital life was then and has continued a happy one, there was therefore no background of domestic discontent. However, the birth was extremely difficult, the patient having been in labor for three to four days, and when finally delivered she suffered an extensive third-degree tear. From the beginning of her confinement she had lost confidence in her obstetrician and attributed her misfortune to improper care. The puerperium lasted six weeks, during which time she ran a high fever, and for a year afterward was "worn out" and unable to take care of her child. For several months after this pregnancy she was troubled by

an excess of milk; it came in great quantities and a pump had to be used three to four times daily for a month or more in order to draw off the excess which the baby could not take. She also perspired profusely while nursing the child, and she was also subject to palpitation which was brought on by any slight excitement. Easily upset emotionally, she often wept without adequate cause; reading a tragic novel made her uncontrollably lachrymose. Emotional instability has continued without great modification until the present time. There were slight exacerbations of symptoms during her two succeeding pregnancies which occurred respectively ten and sixteen years after the first.

Symptoms of Ischæmia.—About four months after her first pregnancy she noticed a sore spot on her left fore-finger which was thought to be a felon. Poulticing the finger aggravated her symptoms. A week later the skin of the tip of the finger and also the deeper tissues sloughed off and did not heal for nearly a year. Since this first experience she has had many more sloughing pustules, involving at one time or another all of the fingers on her two hands except her two ring fingers and thumbs. Two weeks prior to her first entry her right foot had become similarly involved, though for four to five years she had noticed occasional cyanosis and blanching of both lower extremities. In the course of a day her upper extremities are ordinarily subject to repeated attacks of ischæmia. These begin with a sensation of numbness and tingling associated with marked cyanosis, which in turn is followed by blanching which may last for a half hour or more. Anything which makes her nervous or excited will regularly bring on an attack of ischæmia. Thus, when Doctor Cushing showed her to a clinic, the immediate effect of the ordeal was a complete blanching of all four extremities with a sensation of numbness, and after the clinic she wept copiously and wept yet again when telling of it two days afterwards.

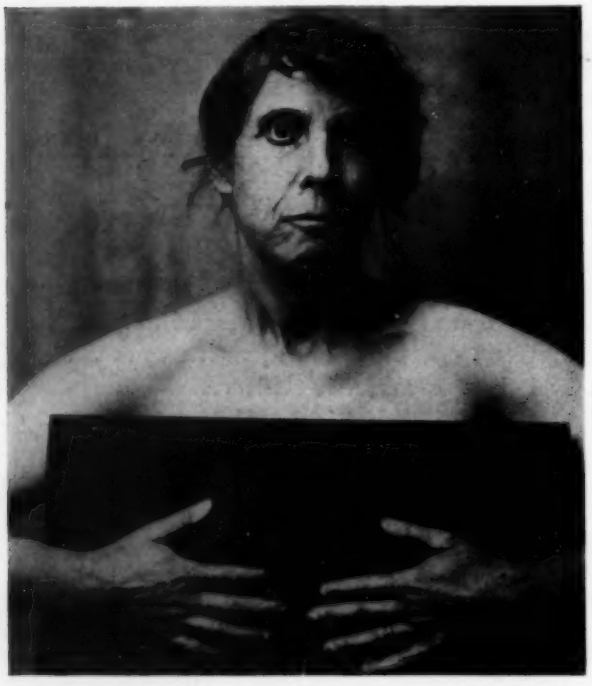

FIG. 1.—Patient's upper extremities showing marked sloughing of the terminal phalanges of both index fingers (pre-operative).

The patient's hands have proved to be a barometer of the weather, being much worse when cold or moist weather is impending. She always dreads the coming of winter. On a winter's morning while still in bed she feels no distress at all, but on arising her hands and feet become almost immediately blue except for the tips of her fingers which usually become dead white without initial cyanosis. Such attacks, especially those occurring in the morning, were associated with an agonizing ache of her hands, the movements incident to putting on her clothes with her hands in this state being particularly painful. She is accustomed to taking violent exercise in order to warm up her extremities, and this indeed has become a morning chore. Three or four times in the course of the day she soaks her hands in warm water, which usually relieves the pain. When her arms hang pendant she is conscious of a sensation of tightness in her fingers, and on account of this is inclined to walk and to sleep with her arms in a flexed position.

First Entry.—Examination showed a somewhat irritable but healthy-looking and intelligent woman whose hands were covered with white gloves for the sake of increased warmth. Blood pressure 104/72. Urine and blood showed nothing remarkable. Heart sounds normal. Peripheral arteries not thickened and pulsation in peripheral arteries apparently normal. The only important positive findings were in her hands and feet. Proximal to the metatarsalphalangeal joints her hands appeared to be fairly normal. The fingers, however, were grossly affected; they were shiny, and the skin covering them was thin and atrophic. The nail of the right index finger had practically disappeared, evidently as a result of repeated small areas of necrosis, which the patient herself called "sore spots." At times the fingers were a deep blue with white spots on the tips of the

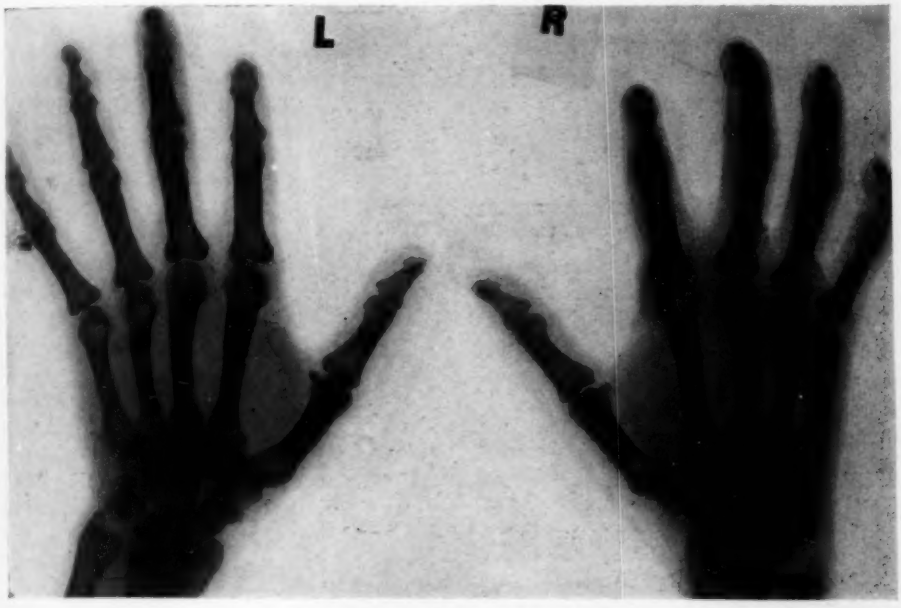

FIG. 2.—An X-ray of patient's hands showing the flattening of the terminal phalanges of index and middle fingers.

fingers, at other times they were red with the same white spots present on the tips. Her hands were always cold. They did not grow pale when held up in the air, but became cyanotic when hung down. There was no sign of organic obliteration in her radial arteries. Her *feet* were cold, moist and clammy. Most of the toes were dead-white in color except for several which were a dark mottled blue. There was a slight swelling of the right fourth toe, the dorsal aspect of which was habitually shiny and was covered in places with scaly cornifications. This, the patient explained, was the remains of a sore spot which occurred three to four weeks before. *After hanging her legs over the edge of the bed they both became intensely blue.* X-ray of the hands showed portions of the terminal phalanges of both index fingers and of the right middle finger missing. The bones elsewhere and those of the feet were normal. Photographs of her hands and feet are shown in figures 1 and 3, and X-rays of her hand in figure 2.

During nine days' stay in the hospital the patient had daily application of Esmarch's tourniquet to her right arm, three times for three minutes at a time with about five minutes in between each application (see Cushing, 1902). After several days the "flush," on release of the tourniquet, passed rapidly down the right upper extremity to the metacarpophalangeal joint, then more slowly to the tips of the fingers. During the first days in

which the tourniquet was used, the tips of the fingers were not affected by the flush, and the patient felt that this régime had made her right hand more comfortable during the day. Doctor Cushing also prescribed a hot toddy of brandy every morning (before arising). With due allowances for mental concomitants, it was obvious to the patient and to those who examined her that the brandy diminished the frequency and severity of her ischæmic attacks for a period of at least two hours after it was taken. She was accordingly discharged with directions to continue the tourniquet and morning hot toddies.

FIG. 3.—Patient's lower extremities before operation.

Second Entry.—Four months later (February 24, 1927) the patient returned, and reported that though the hot toddy-tourniquet régime had made her more comfortable she was still having a great deal of pain, especially in her right arm. She was accordingly readmitted, and physical examination at this time was as before except that several new small sloughing sores had formed on her fingers (second and fifth on the right). On March 2, 1927, Dr. John Homans carried out a periarterial operation on her right radial artery. During this manipulation the artery shrunk so that no pulsation could be felt. Following the operation her skin temperatures were carefully studied with galvanometer and thermocouple. No material alteration in the temperature of her hands was made out. From subsequent observations it was evident that the operation had accomplished nothing.

Third Entry.—Patient returned to the hospital for further observation on April 9, 1927, and as Dr. Norman Royle of Sydney was visiting Boston at that time, it seemed desirable to give the patient the benefit of a right-sided cervical ramisectomy, and Doctor Royle was accordingly invited to make the operation.

Pre-operative Examination.—The patient was studied carefully by three observers prior to operation, but only such findings will be recorded here as proved of significance to her post-operative picture.

Eyes.—Pupils were equal, regular, large, and reacted normally to light and to accommodation. Extra-ocular movements normal. No strabismus, ptosis or enophthalmus. Ophthalmoscopic examination showed sharply-outlined discs and unusually small arteries, in places being almost thread-like. The calibre of the retinal vessels was equal on the two sides.

Peripheral Pulses.—Various observers noted periodic fluctuations in the amplitude of her peripheral pulses. One examiner made the following note. "Her radial and ulnar pulses are equal and full on the two sides, though from time to time their intensity varies considerably. The femoral, popliteal and posterior tibial pulses were palpable on both sides, though the posterior tibial was felt with difficulty on the right. On one occasion the right posterior tibial was not palpable at all, while on the left it was vigorous. The dorsalis pedis could not be felt at 4 P.M., April 9, though at 3 P.M. when the patient was out of bed, Doctor Homans stated that he could feel it readily, and Doctor Royle had felt it the day before. At 9 P.M., April 10, the right posterior tibial was again impalpable."

Blood Pressure.—As there was some diversity of opinion concerning her blood pressure readings, they were taken on several occasions, and the same observer found them to vary from ten to twenty points even when taken in the same limb with patient prone. This was probably to be associated with the varied intensity of the pulse. There was also marked discrepancy in her blood pressure as determined in her leg and in her arm. Thus, on April 9, between 4 and 5 P.M. the following readings were obtained: right arm, 100/70; 95/60; 90/45; left arm, 90/70; 80/40; 95/50. At 9 P.M., April 10, left leg (popliteal space), 160/105; 155/110; 160/100; right leg (popliteal space), 140/75; 145/80; 135/78. The arms taken immediately afterward gave the following readings: right arm, 95/60; 90/55; 98/55; left arm, 85/50 on three occasions.

Extremities.—The fingers of the two hands had changed but little since the conditions described in the first entry. The middle three fingers were cold, shiny and stiff, and during ischæmic spasms looked like tallow candles. Both index fingers showed marked evidence of atrophy of the terminal phalanx with necrosis of the nail. Pain and temperature perception was greatly diminished in the terminal phalanges. It was noted in the feet that any slight manipulation tended to bring on an attack of cyanosis.

Cutaneous temperature readings with thermocouple-and-galvanometer technique were made of face, trunk and extremities before and on several occasions after operation. These findings are recorded below in Table I. It will be noted that prior to operation, temperature in corresponding points on the two sides of the body were nearly equal. Thus the average temperature of five points on the feet was 31.3 on each side (April 10th).

Reflexes: Biceps, triceps, knee and ankle jerks were all equal and rather unusually active. Doctor Royle called our attention to the fact that when the patient sat on the edge of a table with her legs hanging pendant, the phase of relaxation of the jerk on each side was somewhat more prolonged than that of a normal individual under the same circumstances. The biceps jerks also were somewhat slow to relax, and by successive taps on the tendon at three to four per second the arm became completely flexed at the elbow, while in a normal individual it was not possible to produce such fusion of separate tendon responses. Kymographic records were obtained of the knee jerks, but owing to inaccuracies attendant upon records in which the inertia of the leg must be overcome, the measurements of duration of the response are of little value. Slow-speed cinematograph films were also taken of her knee jerks.

Muscular Strength.—With an ergometer patient was able to squeeze 25 kilos with her right hand and 25 to 27 with her left. Power was equal in both lower extremities.

Operation (April 11, 1927, Doctor Royle and Doctor Horrax).—With the patient on her back, head rotated to the left, an incision two inches long was made just above the clavicle at an angle with it of about 45 degrees. On separation of the muscles the brachial plexus was exposed, and the rami running from the fifth, sixth, seventh and eighth trunks to the superior cervical ganglion were divided. The rami from the first thoracic trunk were also divided. The patient was then turned on her left side with her flank elevated in the "kidney" position. Through a long incision extending from the costovertebral angle to the anterior superior spine, the latissimus dorsi was divided and the peritoneum reflected inward. The rami of the second, third, and fourth lumbar ganglia were then exposed and divided and the lower end of the sympathetic trunk was also severed.

Post-operative Course.—Patient stood the operation well and made a prompt post-operative recovery. The lumbar rami were sectioned at 3:07 P.M. Ether was discontinued at 3:15, and at 3:30, Doctor Cushing tested her knee jerks and observed that while the left was still brisk and prolonged, the right was noticeably brief and difficult to elicit. At 3:40 it was noted that the circulation in the right fingers appeared somewhat better than in the left, and when the finger-nail was pressed color returned in three seconds on the right and in five seconds on the left. At 3:41 *both* posterior tibial pulses were equal and ample, while immediately before operation the right posterior tibial could scarcely be felt. At 3:46 blood pressure of right arm was 108/70; left, 100/60. At 3:55 inequality of knee jerks was much more marked than at 3:40, the right being very difficult to elicit. The toes of the right foot were much pinker than those of the left. At 4:01 Doctor Royle demonstrated the difference in "tonus" of the two limbs by placing his hand in the popliteal space and raising the knee quickly. On the operated side the heel tended to drag along the operating table. On the normal side a contraction was evoked in quadriceps by the sudden elevation of the leg, and this caused the heel to be raised from the operating table for one or two seconds before it fell back. This difference between the two sides was striking and continued to manifest itself throughout her entire stay at the hospital. At 5:00 P.M. she was taken to the galvanometer room for readings of skin temperature on the two sides, where it was found that the temperature of her right hand was of an average of 1.5 degrees higher than that of the left. In the feet, however, a difference of 3.2 degrees was evident *just two hours after the rami had been cut* (left foot, 31.0°; right foot, 34.2°; average of five positions on each foot).

The reflex changes observed immediately after operation still persisted the next day. On testing the resting tension of her quadriceps tendon by gently moving the patella laterally, it was found that the left was much less freely movable than the right, indicating a well-marked difference in the resting tonus of the two quadriceps muscles. Patient complained of weakness in her right arm with pain in her shoulder. As later observation showed, the weakness and pain of right upper extremity increased for several days and persisted for three to four months, indicating that some of the roots of her brachial plexus had been traumatized during the operation, probably by retraction. The upper portion of her right trapezius and the belly of the supraspinatus muscle underwent noticeable atrophy, showing that the functional activity of the spinal accessory nerve had also been impaired. For a month she was able to squeeze only 5 kilos on the ergometer with her right hand, as compared with 25 to 30 in her left (and 25 in her right before operation). On June 2 she squeezed 10 kilos with her right hand, on June 22, 16 kilos, and on July 27, 25 to 29 kilos, indicating that by that time her motor power had completely returned. On September 14 she squeezed 31.5 kilos with her right hand.

Several days after operation it was observed that she had developed a marked right-sided Horner's syndrome. The right pupil was 2 mm. smaller than the left, the right globe was less turgid than the left and had sunk noticeably into the orbit. On the 13th of April there was a difference of 3° in the temperature of her two cheeks, but this gradually passed off. No difference in the color of her two cheeks was noted on the record, though it may have existed.

In the preceding notes we have described briefly the immediate effects of the patient's right-sided cervical and lumbar ramisectomy. She was under daily observation in the hospital until discharge (April 26, 1927), after which she was seen and carefully studied at intervals of six weeks during the year. She was last seen on March 30, 1928. The findings of particular significance are those which persisted throughout the year, and we may summarize them as follows:

Circulatory Changes.—The operation of ramisection was carried out primarily to improve the circulatory condition of the patient's extremities. Subjectively patient is now unaware of any difference in the temperature of her two upper extremities. She continues to wear mittens around the house and rejoices now that warm weather has once more commenced. Her fingers still become periodically blue and purple and are extremely

tender, especially in the morning on awakening. In her lower extremities, however, she is conscious of very marked difference in temperature, the right being warmer and more comfortable. Since her operation she has had *no attacks of cyanosis or pallor of her right foot,* but she still continues to have attacks of ischæmia with marked cyanosis in her left foot five to six times a day, and whenever she sits on the edge of a chair or a table with her legs hanging pendant. The patient states that at night in bed she can always feel the difference in temperature between her two legs and warms up the left one with her right. Seven months after the operation she had a small accidental abrasion of her right inner malleolus which healed without scarring after two weeks.

Objectively (a year after operation) the circulatory condition of the two upper extremities showed no obvious difference, the color of the right being if anything a little paler than the left, and the right fingers are stiffer than the left. Radial pulses were equal on the two sides, but from time to time both varied somewhat in intensity. In her lower extremities, on the other hand, there is marked difference in color and moisture, the right being pink and dry, the left usually cyanotic and moist, especially if exposed. When patient was last seen she had, while sitting on the edge of the bed, a typical ischæmic spasm in the left foot with marked cyanosis and slight pallor at the ends of the toes. The posterior tibial pulses could be felt on both sides, but were stronger on the right, especially during the ischæmic attack of the left foot. The dorsalis pedis pulse could not be felt at all on the left and was just perceptible on the right.

Blood Pressure.—Prior to patient's operation a year ago it was noted that the blood pressure of the two arms varied and a great difference in pressure was noted between the arms and the legs. This afternoon the right arm was 95/60, left 90/55; right leg 150/80, left leg 155/95. All these readings were taken with the patient lying prone with her clothes off.

TABLE I.

Temperature of Corresponding Points on Two Sides of Body Before and Shortly After Right Cervical and Lumbar Ramisectomy.

Position	April 10 *		April 11 †		April 13 ‡	
	Right	Left	Right	Left	Right	Left
Cheek	32.4	31.4	31.9	29.6	34.4	31.6
Chest	34.1	34.4	34.1	33.1	35.1	33.1
Upper arm	32.4	32.1	33.1	31.7	31.4	29.6
Olecranon	34.2	34.2	34.8	33.6	33.4	32.9
Finger-tips 1	29.0	29.5	31.8	31.1	27.3	27.2
Finger-tips 2	27.3	27.6	32.0	30.4	27.5	27.6
Finger-tips 3	26.4	26.3	31.6	30.0	26.3	26.5
Finger-tips 4	26.5	26.0	31.8	29.6	26.0	27.3
Finger-tips 5	26.3	26.6	31.6	29.5	27.2	28.0
Palm	32.9	32.8	33.6	33.4	29.1	31.4
Dorsum hand	30.6	29.8	32.4	32.0	29.0	29.7
Knee	34.2	33.9	33.3	31.3	33.5	31.2
Instep	31.2	31.8	33.5	30.7	33.5	29.3
Inner malleolus	32.3	32.8	34.7	32.4	34.3	30.6
Outer malleolus	32.1	31.8	33.8	31.7	33.7	29.4
Dorsum foot	—	—	34.5	30.4	34.4	28.9
Great toe	30.8	30.3	34.5	29.6	34.7	27.9

* April 10, 1927, 24 hours before operation.
† Two hours after operation.
‡ Corresponding determinations were also made on April 20 and 26, with substantially the same results

*Cutaneous Temperature.**—Prior to operation the temperatures of corresponding points on the two upper and the two lower extremities were approximately equal. Within two hours after operation there was a slight difference in the temperature of the two hands and a marked difference in the two feet. Illustrative values from a large number of consistent readings before and shortly after operation are given in Table I.

The following observations on skin temperature made a year after operation may be given as recorded in her clinical history.

TABLE II.

Showing Approximate Equality in Temperature (in Degree Centigrade) of Corresponding Points on Two Sides of Body After Patient Had Been Covered for One Hour (March 30, 1928).

Position	Right	Left	Difference †
Forehead	33.5	33.8	0.3 L
Temple	34.2	34.8	0.6 L
Cheek	35.3	35.5	0.2 L
Clavicle	34.9	34.6	0.3 R
Chest	35.3	35.5	0.2 L
Upper arm (dorsum)	34.0	34.0	0.0
Olecranon	35.4	35.5	0.1 L
Vena cubiti	34.5	34.6	0.1 L
Lower arm (dorsum)	34.4	34.6	0.2 L
Finger-tips 1	32.2	32.1	0.1 R
Finger-tips 2	31.8	30.8	1.0 R
Finger-tips 3	30.8	30.2	0.6 R
Finger-tips 4	30.7	30.1	0.6 R
Finger-tips 5	31.9	30.2	1.7 R
Thenar	33.7	33.7	0.0
Hypothenar	34.9	34.8	0.1 L
Palm	35.0	34.8	0.2 R
Dorsum of hand	33.6	33.4	0.2 R
Knuckles 1	33.4	33.8	0.4 L
Knuckles 2	32.9	32.7	0.2 R
Knuckles 3	32.5	33.0	0.5 L
Knee	33.5	33.4	0.1 R
Calf	35.4	34.9	0.5 R
Inner malleolus	34.2	33.7	0.5 R
Outer malleolus	34.4	34.3	0.1 R
Dorsum of foot	33.5	32.8	0.6 R
Instep	34.1	33.9	0.2 R
Toes 1	34.3	33.8	0.5 R
Toes 2	34.4	33.8	0.6 R
Toes 3	34.2	33.6	1.6 R
Toes 4	33.5	32.7	0.8 R
Toes 5	32.5	32.6	0.1 L

March 30, 1928. Patient came to hospital this afternoon at 1:30 and was immediately put to bed, clad in a hospital nightgown, in the galvanometer room. The room

* All determinations were made with the thermocouple recently introduced by F. G. Benedict (1928) for study of skin temperatures. Readings can be made within six seconds of the time the metal junction is placed on a given area of skin. The apparatus was loaned to the hospital by the Carnegie Nutrition Laboratory, and I wish to record my indebtedness to Doctor Benedict for his personal supervision of the early observation and for his generous criticism of results.

† R.= right higher than left: L.= left higher than right.

temperature at that time was 26° (Centigrade), and she was well covered and directed to keep her arms and legs under the bed clothes for an hour. She was watched through a window, and coöperated admirably. Skin temperatures were made by means of the Benedict thermocouple, as were previous determinations, and full precautions were taken to insure accurate readings of standard temperatures and equal exposure of all corresponding points which were recorded on patient's body. Readings were always made from

TABLE III.

Showing Difference in Temperature of Corresponding Points on Two Sides of Body After Alcohol Rub and Exposure to Room Temperature (25°) for Ten Minutes.

Position	Right	Left	Difference
Forehead	33.4	34.5	1.1 R
Temple	33.7	34.1	0.4 L
Cheek	34.6	35.1	0.5 L
Clavicle	34.1	34.3	0.2 L
Chest	35.3	34.8	0.5 R
Upper arm	32.0	31.0	1.0 R
Vena cubiti	33.7	34.0	0.3 L
Olecranon	34.0	34.3	0.3 L
Finger-tips 1	32.9	32.2	0.7 R
Finger-tips 2	31.7	28.3	3.4 R
Finger-tips 3	29.0	28.3	0.7 R
Finger-tips 4	29.5	29.8	0.3 L
Finger-tips 5	30.3	29.9	0.4 R
Thenar	32.8	33.1	0.3 L
Hypothenar	32.9	33.3	0.4 L
Palm	33.8	34.8	0.1 L
Dorsum of hand	32.5	32.8	0.3 L
Knuckles 1	32.2	33.4	1.2 L
Knuckles 2	32.8	32.2	0.6 R
Knuckles 3	32.7	32.2	0.5 R
Knee	30.8	30.2	0.6 R
Shin	32.5	31.9	0.6 R
Calf	34.4	33.6	0.8 R
Inner malleolus	31.1	31.0	0.1 R
Outer malleolus	31.4	30.2	1.2 R
Dorsum of foot	32.8	30.4	2.4 R
Instep	33.5	32.2	1.3 R
Toes 1	33.8	33.0	0.8 R
Toes 2	31.9	30.0	1.9 R
Toes 3	31.8	29.0	2.8 R
Toes 4	31.9	28.6	3.3 R
Toes 5	33.3	28.3	5.0 R

right to left; that is, a point selected for measurement on the right cheek was immediately followed within twenty seconds by readings from a corresponding point on the left cheek.

Observation 1.—After patient had been well covered for an hour, readings were taken at corresponding points on the two sides of her body, as indicated in the above table. Each point was uncovered just before the reading was made, and it was observed that a fall of as much as .5° C. might occur within one minute after a given point was exposed. In reading the successive finger-tips, those of the fifth finger, being last read, were colder than those of the first since they had been exposed for a somewhat longer time; but each corresponding finger on the two sides had been exposed for approximately

the same length of time when the reading was made. Because of the tenderness of patient's fingers and toes, it was found impracticable to obtain such readings from beneath the bed clothes. The absolute values obtained for a given point are indicated in Table II, the actual figures having been calculated after the observations were made.

The determinations in Table II were made between 2:35 and 3:00 P.M. It is perhaps worthy of note that points on face, body and upper arm are almost exactly equal, while the finger-tips on the right are on an average .8 of a degree warmer than those on the left. Similarly the temperatures of the right foot are slightly greater than those of the left, even though patient had been covered for an hour.

Observation 2.—In order to determine which side was most affected by artificially induced heat loss, patient's arms and legs were given an alcohol rub for five minutes and she was then permitted to lie exposed to room temperature for ten minutes (room temperature 25° C.), and then the following series of observations were taken. It is worthy of note that when these observations were commenced the left lower extremity was slightly cyanotic, while the right continued pink.

The readings given in Table III indicate that after equal exposure of the two sides the fingers of the right hand tend to be very slightly warmer and the toes of the right foot very markedly warmer than those of the left. It is interesting that the difference in temperature of the toes is more marked for the outer toes than for the inner; corresponding points on the feet other than the toes show similar difference.

Observation 3.—Patient lay prone and quiet during the first two observations. At 3:45 she was permitted to sit up on the edge of the bed so that her feet hung pendant. Five minutes later an attack of cyanosis was evident in her left foot, and in view of this readings were again taken on the toes of the two feet. In Table IV the results of these observations are given. It will be seen that there was an average of 3° C. difference in the temperature of the two toes at this time, and the color difference was striking. This completed the series of thermal observations, the last being taken at 4:10 P.M.

TABLE IV.

Temperatures of the Toes During an Attack of Ischæmia of Left Foot.

Position	Right	Left	Difference
Toes 1	30.1	26.6	3.5 R
Toes 2	27.7	24.9	2.8 R
Toes 3	28.2	25.1	3.1 R
Toes 4	28.0	25.0	3.0 R
Toes 5	30.8	25.6	5.2 R
"Ball" of foot	31.0	28.4	2.6 R

The other changes in the case which have persisted since operation may now be mentioned.

Horner's Syndrome.—The right pupil has continued about 1–2 mm. smaller than the left throughout the year. A slight difference in size of the two palpebral fissures is still noticeable but enophthalmos on the right has almost entirely vanished. Except at the beginning there has been no obvious difference in the temperature of the two sides of the face, nor has there been any difference in color. On July 27, 1927, the following note was made concerning her fundi. "Careful examination showed clearly-defined disc margins and normal physiological cupping. It is quite evident, however, that there were more small arteries crossing the fundus on the left side than there were crossing the right fundus. One gained the impression that the retinal arteries on the right side were somewhat larger than those on the left." Examination a year after operation showed that this was still true, the difference being still marked, especially as regards the veins.

In passing, we may note that the difference in size of the retinal vessels is a feature of sympathetic paralysis to which Horner (1869) called attention in his original description of the syndrome. The present case is of interest from the anatomical standpoint because only the first dorsal ramus was severed. The symptoms were definitely less marked than in cases of complete sympathetic paralysis. The pupillary constriction was perhaps as much as one would anticipate in a case of complete paralysis, but the enophthalmos was less marked and less persistent and there was no obvious vasomotor change in the face. This suggests that in this instance at least the control of the iris comes chiefly from the first thoracic ramus, and that the vasomotor control of face and conjunctivæ, normally associated with the Horner syndrome, comes from rami lower down.

Sensory Disturbances.—While taking blood pressure (March 30, 1928) it was noted that compression of the right leg was much more painful to the patient than compression of the left. She remarked that since her operation the right leg had continued to be rather "tingly" and somewhat more sensitive and hyperæsthetic to touch than the left. She also remarked upon this when I was testing her knee jerk, the right patella seeming much more tender to her than the left. Such hyperæsthesia may be in some way associated with disturbance of peripheral circulation resulting from ramisectomy.

Another interesting sensory phenomenon is that all operative incisions have remained markedly hyperæsthetic, even though healing occurred *per primam.* The cicatrix of her periarterial incision is still exquisitely tender. This is also true of her cervical incision, but less so of her lumbar. I have no explanation to offer for this rather striking fact.

Reflex Changes.—Recent discussion concerning the relation of the sympathetic system to functional activity of skeletal muscle renders the reflex changes observed in this case interesting and important. Twenty-three minutes after the lumbar rami were severed (when the first examination of her reflexes could be made) there was an obvious difference in the character and briskness of the patient's knee jerks which, immediately before operation, had been, as far as we could determine, identical. The depression of the knee jerk on the operated side, though it became less marked with the lapse of time, persisted for a year after the operation, and it is still noticeable. When the patient lies prone and the resting tension of quadriceps is tested by moving the patella laterally, it is obvious that the quadriceps on the operated side is under considerably less resting tension than on the normal side. This difference was evident even during sleep. The difference in the physiological condition of the muscles on the two sides was brought out very strikingly in the following way. When the patient was placed on a table so that her legs hung pendant, the right knee jerk, though less brisk than the left, was followed by seven or eight pendulous swings of the leg before coming to rest, while on the left side the jerks, though more ample, caused the leg to swing only two or three times before coming to complete rest. The relaxation on the left continues to be much slower than on the right. This difference between the two sides has been observed on at least twenty occasions since her operation. Moreover, when, instead of eliciting the knee jerk, the legs were lifted to a horizontal position and released suddenly, the patient's attention being at the time otherwise occupied, the right limb swung ten or twelve times before coming to rest, while the left was quiet after four or five swings. These differences have diminished slightly during the course of the year, but are still marked.

Immediately after operation the right ankle jerk was less brisk than the left; this difference has also persisted and is quite as striking as the knee jerk. It is difficult, however, to know whether there is less resting tension in the right gastrocnemius muscle than the left, for there is nothing corresponding to the patella with which to measure the resistance to previously imposed lateral deviation.

In the upper extremity the existence of a post-operative brachial neuritis for three or four months after the operation rendered comparative observations upon the biceps and triceps jerks of little value. However, after her motor power had completely recovered, as was evident on July 27, 1927, the right biceps jerks have continued during the year to be less brisk than the left, and this was true also of the response to triceps.

DISCUSSION

The Relation of the Sympathetic Nerves to Muscle Tonus.—Liddell and Sherrington (1924, 1925) have given reasons for believing that the stretch reflex is the mechanism by which the tonus of skeletal muscle is maintained. In another paper the present writer (1928*a*) has offered clinical evidence pointing in the same direction. Since the knee and ankle jerks are fractional manifestations of the stretch reflex, they serve as indices of the tonic condition of the muscle from whose tendon they are elicited.* One may conclude, therefore, from the diminished knee jerk following immediately upon sympathectomy that the tonus of the quadriceps has been notably diminished in this case as a result of the operation. The greater tendency of the right leg to swing when hanging pendant, and the relative flaccidity of the right patella give further evidence of the same thing.

The fact that sympathectomy leads to a diminution in tonus of human beings is important and calls for comment. The same phenomenon has been observed repeatedly in well-controlled observations upon animals, notably by Kuntz and Kerper (1926), and also in man by Kuntz (1927). It is to be noted, however, that tonus *though diminished is not completely absent,* which is true also of spastic cases following ramisectomy (Royle, 1924; Steele, 1927). This in my opinion definitely precludes the theory that the sympathetic system governs muscle tonus. One might suggest that sympathectomy causes an increase in the threshold of the stretch reflex. Reasons have been offered elsewhere for looking upon the muscle spindles as the chief afferent end-organs of the stretch reflex (Fulton, 1926, 1928*a*). But alteration of the innervation of muscle-spindle's intrafusal fibres cannot well be invoked to explain the reflex changes following upon ramisectomy, since Hinsey (1927) and Hines and Tower (1928) have recently proved that the intrafusal fibres receive somatic innervation, and not sympathetic as some have supposed. Consequently some secondary factor such as altered blood supply or, less likely, the interruption of accessory sympathetic fibres which are supposed to supply skeletal muscle fibres, may play a rôle in producing this result. This interpretation, moreover, does not require the postulation of a vague dual mechanism of muscular activity, and it is compatible with the view, well supported experimentally, that the stretch reflex is responsible for the maintenance of muscle tonus.

Circulatory Changes.—It is commonly believed that the circulatory alterations which follow upon sympathectomy gradually become compensated (see Lewis, 1927). In the present case, however, there has been very slight change in the circulatory condition of the right foot during the year; in fact the foot is about the same now as it was two hours after ramisectomy. The clinical condition of her hands was little affected by the operation although there has

* This generalization cannot be applied unrestrictedly, for in the spinal animal knee jerks may be present in a relatively atonic muscle. This is a somewhat special case, discussed at length elsewhere (1926, Chs. XI and XXI), and does not affect the present argument.

been a slight and probably significant elevation of temperature of the right hand. The ischæmic process had evidently progressed so far on that side that removal of the sympathetic fibres was without effect. This is perhaps not surprising in an advanced case of Raynaud's disease, since in such instances the capillary walls become constricted (Lewis, 1927, p. 283) and probably fibrosed beyond repair.

The fluctuation in the blood pressure and pulse of the present case is worthy of note. On several occasions the posterior tibial pulse seemed to disappear while being palpated, and its failure ushered in an attack of cyanosis of the foot. Doctor Homans' observation that the radial artery became pulseless during manipulation is also significant. All these facts strongly suggest that the vascular spasm in Raynaud's disease involves the great vessels of the extremities as well as the small. The capillary fibrosis which eventually occurs is probably a secondary result of longstanding ischæmia.

The fact that ramisectomy has led to definite improvement in an extremity which had only lately become involved by the ischæmic process strongly favors the view, well supported on other grounds, that Raynaud's disease is due primarily to instability of the sympathetic vasoconstrictor centres of the extremities. Whether such factors as a constitutional tendency to abnormal agglutination of corpuscles in the peripheral capillaries* (Iwai and Meisai, 1925, 1926) also operate in the production of Raynaud's disease, must be left open. In view of the well-recognized fact that emotional disturbances tend to aggravate the symptoms in cases of Raynaud's disease, it is difficult to believe that the malady is due primarily to a defective melieu of the corpuscles. But the improvement following ramisectomy is not a logical objection to the

* Iwai and Meisai (1925) found that citrated blood of a patient with Raynaud's disease invariably clots if allowed to stand in a water-bath at 0° C. for ten minutes, the clotting taking place no matter how vigorously the receptacle was shaken. On again warming to 31° C. or higher the clot so formed redissolves. The patient's serum acted equally well on the patient's own corpuscles washed with normal saline and on the washed corpuscles of any other normal individual in a dilution of 1–1,000, but if agglutination were allowed to take place and the supernatant serum removed, it was found no longer to have any agglutinating action on the patient's cells or those of a normal control. If erythrocytes, after agglutination with patient's serum, were washed three times with normal saline at a low temperature and then with saline at 33° C., the last washing still showed the agglutinating power of the original serum. To prove that this reaction might take place equally well in a capillary vessel, the blood was run through a fine capillary loop warmed in a water bath. This it did with ease until the tube was cooled when agglutination and plugging of the tube took place, the agglutination being such as to show in the tube areas of closely clumped corpuscles separated by areas of clear serum. On warming, the corpuscles re-dissociated and the flow of blood was restored. The same phenomenon was seen in the capillaries of the patient by focusing a microscope on the patient's cornea and bathing it with saline cooled to 10° C., the agglutination being accompanied by pain. Further to prove the theory that *lowering of the temperature* alone caused the symptoms of the disease, a piece of ice was placed on various parts of the patient long enough to obtain a lowered temperature in each part tested. All regions of the body (*e.g.*, the abdomen) gave the typical picture of cyanosis and pallor so characteristic of the malady as observed in the extremities. This work has since been further confirmed by similar experiments by the same investigators on another case of Raynaud's disease (1926).

hypothesis of the Japanese workers, since increase in diameter of the peripheral vessels following constrictor paralysis would offset an abnormal tendency toward intravascular agglutination. The view of Iwai and Meisai suggests that Raynaud's disease and the Buerger's syndrome have much more in common than has previously been supposed.

Many fresh problems concerning the vasomotor control of the skin have been opened by the publication of Sir Thomas Lewis's monograph (1927) on the cutaneous blood-vessels, and this case has been analyzed as far as possible in the new light of his stimulating investigation. One must, however, await the study of further cases of Raynaud's disease before it will be possible to consider the relation of this malady to the broader problems of the normal cutaneous circulation.

SUMMARY

A case of Raynaud's disease is described in which ischæmic symptoms of the four extremities were equally advanced on the two sides of the body. A right-sided cervical and lumbar ramisectomy was carried out, and immediately after the operation all deep reflexes, which before had been equal, were markedly depressed on the operated side. In the right lower extremity the pulse became more full and the right foot 3° (C.) warmer than the left. There was also a right-sided Horner's syndrome.

The patient has been carefully followed for a year and the altered reflexes, Horner's syndrome and thermal differences have persisted during that period. She has had no further symptoms of ischæmia in her right foot, but her right hand was not obviously benefited by the operation. There has also been a permanent and well-marked diminution of the resting tonus of her right lower extremity since the operation.

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RESULTS OF DELAY IN TREATMENT OF BREAST CANCER

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A recent study of cancer of the breast has been made at the Presbyterian Hospital of Chicago, under the auspices of the American College of Surgeons and in charge of Doctor Greenough of Boston. One hundred cases occurring in the years 1917 to 1920 were studied in detail with after results in seventy. The report of these cases will be included in a composite report of similar work done at other hospitals. A brief summary of the cases which were followed through is given in the following table:

Living and well	11
Alive with recurrence	1
Died with recurrence:	
In 1 year	9
In 2 years	19
In 3 years	13
In 4 years	6
In 5 years	2
In 6 years	1
In 7 years	1
Died without recurrence:	
Post-operative death	1
In 1 year	3
In 4 years	2
In 7 years	1
Total	70
Mortality statistics:	
Seven year cures	12
Recurrences	52
Death from intercurrent diseases	6
Percentage of 7 year cures	18.7

These statistics include all cases operated upon, some of which were known to be palliative. None of the primary cases were refused operation.

The duration of symptoms prior to medical consultation and the advice received suggested that a similar study of one hundred cases from 1924 to 1927 might be of interest. The Society for the Prevention and Control of Cancer and the State Boards of Health have expended a great deal of energy in telling the people the importance of early diagnosis and prompt treatment of lumps. Special emphasis has been laid on breast tumors. The amount of propaganda spread through popular lectures, pamphlets, newspaper and magazine publications leaves little doubt that practically every woman knows what cancer of the breast is and the value of early surgical treatment. The following figures show that progress has been made. Further success is not depend-

ent upon more extensive publicity but upon increased public confidence in the ability of surgery to cure.

Duration of Symptoms Prior to Medical Consultation.—In the 1917–1920 period the average delay was 8.6 months. Twenty-eight women consulted their physicians at once or during the first month in which the lump was noted. In the 1924–1927 series the average delay was 5.7 months. Thirty-five consulted their physicians during the first month of their trouble. These two hundred cases represent all classes—rich and poor, educated and uneducated—in the middle west. It is noteworthy that the privileged classes were as slow as the underprivileged in learning the truth about their breast lumps.

In the first group eleven patients delayed operation after it had been advised. Only four of the second group put off the advised operation. The majority sought medical advice only after months of personal observation had led them to believe their condition might be serious. They delayed because of fear; and because of delay lessened greatly their chances of complete eradication of the disease.

Advice Received.—In the 1917–1920 period our education was far from complete. Of the one hundred women who found lumps in their breasts which at operation proved malignant, five were advised by their physicians to leave them alone. One was told to put iodine on the lumps in the axilla. Plaster applications was the sole treatment in one instance. Mastitis was the diagnosis of one lump which was operated upon three months later and which in less than two years had killed the patient with recurrences. A patient who came to the hospital with a typical Paget's disease of the breast and an underlying lump had been using salve to the sore as directed. A tenth woman had had a series of X-ray treatments which resulted in a severe burn. A medullary carcinoma involving one-half of the breast and the axillary and subclavicular lymph glands made the operation a palliative one.

Ninety women were advised promptly to have radical surgery.

We show much improvement in the diagnosis of breast cancer in the 1924–1927 period. Teaching the public to beware of lumps makes the teacher wary. Only two patients of this group of one hundred carcinomatous breasts were advised to leave alone the tumors they had discovered. A third woman of her own volition went to an osteopath and had the lump massaged. Pain and enlargement of the axillary lymph glands suggested that she consult a surgeon.

Ninety-eight per cent. received what today is considered the best advice—prompt radical surgery.

Age.—The average age was 51.8 years, quite in agreement with the usual findings. The oldest was seventy-nine, the youngest twenty-two years. Fifty-seven years difference in the age of breast tissue that developed the impetus for uncontrolled cell growth.

Discussion.—To secure better results in the surgery of malignancy of the breast it is clear that faith in this therapeutic measure is necessary. When the reports of happy end results have in the course of years filtered through to the laity, women will believe that surgery has something to offer besides palliation.

They will confer with their medical advisors as soon as a lump is found in the hope that a cure may still be effected. They will learn that cancer starts as a local disease and can be completely and permanently removed during that stage. The follow-up records of 375 cases investigated in England by the Manchester Committee on Cancer show that of the cases operated upon when the disease was confined to the breast seventy-two per cent. were alive at the end of ten years. Of those operated upon after the disease had involved the regional lymph glands only fifteen per cent. were alive at the end of ten years. When the malignancy has advanced to the regional lymph glands it is a systemic disease, and the chances for its complete eradication are slight.

In return for increased confidence shown by early consultation, as accurate a diagnosis as can be made is due every woman with breast trouble. In a woman over thirty-five a nodule, movable or fixed, a bleeding nipple, an eczema, or a localized, non-traumatic pain requires painstaking investigation. I am quoting men of wide experience when I say that every breast tumor should be removed and examined microscopically. If benign the case is closed. If malignant, grossly or microscopically, radical removal should follow at once. A tumor of the breast should be watched only when circumstances prevent its removal, and left alone only when it is not a tumor.

THE HÆMORRHAGIC DIATHESIS OF OBSTRUCTIVE JAUNDICE AND ITS TREATMENT

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Despite the employment of a number of remedies that have been suggested for the control and prevention of bleeding in patients with obstructive jaundice, hæmorrhage still continues as one of the important causes of post-operative mortality following surgical intervention for the relief of biliary obstruction. It is true, that even after prolonged obstruction in the extra-hepatic bile passages, a large number of patients with icterus exhibit no abnormality in the manner in which their blood clots. However, in a rather considerable number who seek surgical relief for biliary obstruction, it is found that the blood when shed does not coagulate in the usual interval. Following the employment of current methods used to combat the menace of hæmorrhage in icteric patients, the prolonged extravascular clotting time of the blood can frequently be brought to a more normal level. The occurrence of dangerous or fatal bleeding after operation in such patients, even when the pre-operative coagulation time is normal, is not unusual. Spontaneous lethal hæmorrhages in unoperated patients with obstructive jaundice are not unknown.

Within a year's time, in the Surgical Service at the University Hospital, this hæmorrhagic diathesis was observed in four patients with obstructive jaundice. One died of spontaneous hæmorrhage while being prepared for operation. Another with a markedly protracted coagulation time which remained refractory to the usual methods of reduction, died in coma after having had numerous spontaneous hæmorrhages. A third patient died of parenchymatous bleeding three days after the excision of a benign stricture from the common bile-duct, and another almost lost his life through this dreaded complication.

The first case was in the person of a man of forty-six years, with a normal pre-operative clotting time who came to operation with a jaundice of five weeks' standing. Following preparation with calcium chloride, an obliterating cholangitis was found at operation, and cholecystostomy was done. The first seven post-operative days were uneventful. Then bleeding from the wound occurred, and a hæmatoma formed. Nitrogen retention occurred. After the administration by vein of calcium chloride and of glucose, and the employment of transfusions of whole blood, the hæmorrhagic tendency was controlled, and recovery followed.

In the second case the patient was a man aged sixty-six years, who presented himself with a painless jaundice of six weeks' duration with marked weight loss. Ascites was present and a diagnosis of carcinoma of the pancreas with metastases was made. The clotting time was normal when first examined. Ten days later, it was markedly prolonged and remained so despite the employment of transfusions, calcium and

"Fibrogen" in attempts at reduction. During the last few weeks of life, spontaneous hæmorrhages were frequent. The patient became lethargic and died in coma a little more than three months after the onset of jaundice. Multiple hæmorrhages were found. The cause of the biliary obstruction was a small carcinoma below the juncture of the cystic and common bile-ducts. No metastases were present. The ascites was due to biliary cirrhosis.

Case three was a patient whose gall-bladder had been removed previously, developed a stricture of the common bile-duct. Drainage had been omitted at the first operation. The cystic duct occlusion became insufficient and bile escaped into the peritoneal cavity causing alarming symptoms. Following the evacuation of a large quantity of bile through the operative incision, the patient had an uneventful convalescence.

The sloughing process in the cystic duct probably gradually involved the common bile-duct and biliary obstruction followed. When the patient came for examination with a jaundice of two months' duration the clotting time was prolonged. The patient went home and returned for operation a few days later. Operation (excision of the stricture and the insertion of a T-tube into the common duct) was done despite a prolonged clotting time, after calcium, transfusions, and "Fibrogen" had been ineffective for its reduction. On the third post-operative day severe hæmorrhage into the abdomen occurred and the patient died despite repeated transfusions. A limited necropsy showed the peritoneal cavity to be full of blood.

Case four was that of a woman of fifty-two years of age who came with obstructive jaundice of two months' duration. The clotting time was normal. Pre-operative preparation with calcium chloride was commenced. The patient died suddenly without premonitory symptoms or apparent cause. At the postmortem examination, extensive carcinoma of the pancreas and gall-bladder with metastases was found. Hæmorrhagic casts throughout the intestinal tract explained the sudden death.

The Cause of the Hæmorrhagic Diathesis.—When the bile outflow from the liver is interrupted, retention of the biliary constituents in the blood and tissues follows. Attending this stasis, a destruction of liver tissue with marked morphological changes may ensue, together with a diminution in at least some of the functions of this important organ. An attempt will be made to evaluate the etiologic factors concerned in the genesis of the hæmorrhagic diathesis of obstructive jaundice.

1. *The Relation of Bile Retention to the Tendency to Bleed.*—The belief that the retention of bile in the organism is responsible *per se* for the tendency of icteric patients to bleed is accorded wide credence. King and Stewart[64] on finding the blood calcium decreased in dogs with obstruction of the common bile-duct, suggested that calcium combined with the bile pigment in obstructive jaundice to render the pigments less toxic. King, Bigelow and Pearce[63] later substantiated this alteration in the blood calcium in dogs with biliary obstruction, but believed that the combination of bile pigment and calcium made the latter less available for the clotting process. The delay in coagulation, and the hæmorrhages of jaundice, they suggested, could be accounted for in this manner.

Cantarow, Dodek and Gordon,[9] though believing that a functional deficiency of calcium exists in obstructive jaundice due to an increased amount of bile pigments in the blood and tissues, were unable to demonstrate any constant quantitative diminution in the blood calcium. The serum calcium in icteric patients with no delay in coagulation they found to be normal. Snell, Greene and Rowntree[118] found that following common

bile-duct obstruction in dogs the calcium content of the serum did not vary from the normal. Buchbinder and Kern [8] have recently reported low serum calcium values in three cases of clinical jaundice, and in puppies with obstruction of the common bile-duct. Zimmerman [147] obtained normal values for calcium in the blood of patients and of dogs with obstructive jaundice, and concluded that the employment of calcium as an aid to coagulation rested on no sound theoretical basis. Kirk and King [65] have found that, whereas normally, the diffusible portion of the blood calcium is 72.3 per cent. of the blood calcium, this figure may be reduced to 55.2 per cent. in jaundice. Kirk and King observed similar changes in other conditions, however, in which no disturbance of coagulation occurs.

Vines [131, 132] has found that it is the calcium in the combined state rather than the ionized portion that is necessary for the inauguration of normal blood clotting. In accordance with the suggestions of King and Stewart, and of King, Bigelow and Pearce that bile pigments combine with the blood calcium, it would appear that that portion which Vines states is necessary for clotting is increased in obstructive jaundice. The relation of calcium to the bleeding of icterus will be discussed at greater length in a subsequent section of this paper.

It is now generally conceded that, of the components of bile, the bile acids are the most toxic. However, King and Stewart,[64] of the more recent investigators dissent from this opinion and believe the bile pigments to be responsible for the toxic symptoms occasionally exhibited by patients with obstructive jaundice. The writer has discussed this question in detail elsewhere.[136] Suffice it here to say, that a constant accompaniment of biliary obstruction is the accumulation of bile pigment in the blood and tissues. If bile pigments were toxic for the organism in any degree, certainly all patients with prolonged obstructive jaundice should manifest symptoms of toxemia. As is well known, patients with biliary obstruction frequently continue in good health for a long time.

In consequence of the toxic and hæmolytic properties of the bile acids and their ability to inhibit the coagulation of blood when present in sufficient concentration *in vitro*, the origin of the hæmorrhagic tendency in jaundice is frequently attributed to them. More than twenty years ago, however, Morawitz and Bierich [86] stated that it was unlikely that the bile acids were responsible for abnormalities in the clotting of blood of patients with obstructive jaundice. They found that the addition of ox-bile to the shed blood of a dog in the dilution of one part of bile to twenty parts of blood had very little influence on coagulation. When the ox-bile was added in dilutions of 1:10 to 1:15 the coagulation of the blood was more or less delayed. The addition of one part of bile to five parts of dog's blood completely inhibited coagulation when synthetic bile salts were employed. Very little effect was obtained with dilutions of bile salts of ¼ per cent. Definite inhibition of coagulation resulted, however, when the bile salts were present in ½ to 1 per cent. dilution.

This concentration, according to Morawitz and Bierich, never occurs in the blood of patients with obstructive jaundice.

Gustav Petren [99] in a thorough study of the problem has arrived at the same conclusion. He found that the addition of either taurocholic or glycocholic bile salt in the concentration of 0.61 per cent. would delay the extravascular clotting of ox-blood or of

the venous blood of hospital patients. In eighteen patients with obstructive jaundice of long standing the addition of bile salt in the same concentration was necessary to inhibit clotting. In eight other jaundiced patients, however, the delay in coagulation was obtained with an addition of bile salt in lesser concentration.

Wildegans [142] anastomosed the common bile-duct to the vena cava in a number of dogs. All died after a few days, but in no instance could he demonstrate a delay in the coagulation of the blood.

Elsewhere,[136, 138] the writer has pointed out that the excretion of bile acids is diminished following prolonged exclusion of bile from the intestine. This decrease in bile acid formation obtains when bile is lost from the body in the presence of a complete external biliary fistula as well as when the bile escapes into the peritoneal cavity following traumatic severance of the common bile-duct. After prolonged occlusion of the common duct, the synthesis of bile acids also appears to be interfered with.

Hoppe-Seyler [52] used 30 litres of urine from a jaundiced patient to get a qualitative test for bile acids. Malkoff [78] was unable to detect the presence of bile acids in the urine of a number of icteric patients. In patients with obstruction of the common bile-duct due to malignancy, bile acids were found in the urine early in the course of the jaundice but later could not be demonstrated. Following experimental common bile-duct obstruction in the dog he observed that the bile acids usually disappeared from the urine after a short time.

Brakefield and Schmidt,[7] in studying the excretion of bile components in dogs with obstruction of the common bile-duct found that the excretion of bile acids in the urine gradually decreased to a very small amount. Recently Snell, Greene, and Rowntree [119] have reported quantitative determinations of bile acids in the blood of dogs following experimental obstruction of the common bile-duct. A marked increase in the bile acid content of the blood was observed on the second or third day after severance of the common duct, with maximal values during the second week of obstruction. Thereafter the bile acid in the blood was found to approach the normal level.

(Snell, Greene and Rowntree,[119] in accordance with the view of Weintraud,[140] accept the explanation that a decreased synthesis of bile acid by the liver occurs following prolonged biliary obstruction. One should then rather expect values for bile acids below those observed in the normal animal when bile acid synthesis begins to fail).

Rowntree, Greene, and Aldrich [105] also report quantitative bile acid determinations on patients with hepatic disease. Increased values were present early in obstructive jaundice that decreased to the normal level with long continued biliary obstruction.

It would therefore appear unlikely that the explanation of the tendency for patients with obstructive jaundice to bleed is to be found in a bile acid intoxication. The concentration of bile acids in the blood diminishes with continued biliary obstruction, whereas the tendency toward hæmorrhage is most frequently observed in those patients where the obstruction to the bile flow has been long continued.

2. *The Relation of the Liver to the Hæmorrhagic Tendency.*—The important rôle of the liver in maintaining the normal coagulability of the blood has long been known. Pawlow,[94] and later Bohr,[5] found that when the circulation above the diaphragm was shunted out of the general circulation, that blood drawn from the carotid artery about fifteen minutes later remained incoagulable. Following ligature of the cœliac and mesenteric arteries in a dog, Bohr [5] also observed that blood shed four hours later remained incoagulable for more than two hours. Some years later the same observation was made by Doyon, Morel and Kareff [42] who found that, following the injection

of paraffin into the cœliac axis the blood when shed, failed to clot. In other dogs Doyon and Gautier,[20, 22, 23] excised the intestines and ligated the mesenteric and cœliac arteries with the same result.

In 1894, Corin and Ansiaux [11] had already observed that the blood of dogs poisoned with phosphorus remained incoagulable. Spontaneous hæmorrhages in the tissues of some of these animals were also seen. Doyon [14] found that dogs given 25 to 50 c.c. of chloroform by stomach tube died after a few days and that blood drawn from the carotid artery shortly before death failed to clot. This alteration in the coagulability of the blood was correlated by Doyon, Morel and Billet [30] with the hepatic necrosis that followed the administration of chloroform, and that was responsible for the death of the animals. The same findings were present in phosphorus poisoning. More recently Kerr, Horwitz, and Whipple [62] have found that in the liver injury attending the subcutaneous injection of phosphorus in dogs the animals die in about five days. The blood remains incoagulable and multiple hæmorrhages are usually present.

Doyon and his co-workers [31, 34, 36] have also noted that the injection of a centigram of atropin per kilo into the mesenteric vein of a dog causes the blood to become incoagulable. Injections of atropin into the saphenous vein or into the splenic or renal artery were without effect on the coagulability of the blood. Hepatic artery injections elicited the same effect as portal injections.[35] Later they observed that the forcible injection of atropin into the common bile-duct had the same effect on blood coagulation as when introduced into a mesenteric vein.[25] In the rabbit or guinea pig, common bile-duct or mesenteric vein injections of atropin produced no alteration in blood clotting.[27]

A gram of ox-bile per kilo injected into the mesenteric vein of a dog caused the blood to become incoagulable.[28] Two to three times this amount when injected into a systemic vein did not alter the coagulation of blood.[32] When 1 c.c. per kilo of 10 per cent. solution of taurocholic or glycocholic acid was injected into the mesenteric vein of a dog, the blood also became incoagulable. Following the injection of 5 c.c. of ox-bile into the mesenteric vein of a rabbit, the blood failed to clot when shed.[30] The rabbit died two hours after the injection.

The incoagulability of the dog's blood following the introduction of Witte's peptone into a systemic vein, as first observed by Schmidt-Mühlheim,[67] Doyon also attributes to an action on the liver.[18] After forceful injection of Witte's peptone into the common bile-duct of a dog (.01 gram of peptone per kilo dissolved in 30 to 40 c.c. of normal saline) a marked lowering of blood pressure accompanied by failure of the blood to clot occurred.[26]

After excision of the liver in the dog,[37] and in the frog,[21, 23] Doyon and his associates observed that the blood failed to clot. Mann and Magath [79] state that certain constant changes in the coagulation of the blood are present following hepatectomy in dogs, but do not discuss the nature of the changes observed.

These experiments indicate very definitely that destruction or injury of liver tissue and interference with or diminution of liver function may seriously alter blood coagulation. The nature of the mechanism or mechanisms by which these changes are brought about is not clear. In the alteration of coagulation observed following liver excision it would appear that something essential for blood coagulation had been removed with the liver. Doyon and his co-workers state that liver extirpation removes the source of fibrinogen. Foster and Whipple [47] in a study of blood fibrin state that all available data points to the liver as the only potential source of fibrinogen in the body. Williamson, Heck, and Mann,[144] on the contrary, have indicated that the liver is not necessary for the regeneration of fibrinogen.

The incoagulability of the blood in the experimental animal following mesenteric vein and common bile-duct injections of atropin, ox-bile, and bile salts, and the failure to elicit this alteration after systemic vein or artery injection would indicate that some anticoagulant is liberated following liver injury. Doyon [15, 16] has found that the perfusion of an extirpated dog's liver with saline imbues the perfusion fluid with anticoagulant properties. When such a liver was perfused with the blood from another dog, the blood used also became incoagulable. Doyon [16] has been able to extract anticoagulant substances from other organs and has suggested that these substances are nucleoproteins. Several years before, Conradi [10] had been able to show that the pressure juice of many organs may inhibit the extravascular clotting of blood. Following the injection of thymus and liver extract of calves intravenously in rabbits, Boggs [4] found that in many instances the blood remained incoagulable when shed.

3. *The Clinical Occurrence of the Tendency to Hæmorrhage.*—Though there is no absolute correlation between the duration and intensity of icterus and the tendency of patients with obstructive jaundice to bleed, most instances that came under observation with abnormalities of coagulation have usually had biliary obstruction for some time. Of fifty-eight patients that died of hæmorrhage after operations on the biliary tract for the relief of obstructive jaundice in Swedish Hospitals, Petren [98] found that fifty had been jaundiced for three weeks or more. In only eight instances was the icterus of less than three weeks standing. The duration of jaundice was from five to eight weeks in the patients reported here. Kehr [59] refers to an instance of death from cholemic bleeding after operation when jaundice had been present only for five days.

In a previous section of this paper it has been pointed out that the retention of bile in the organism per se is probably not responsible for the tendency of icteric patients to bleed or for the alteration in blood coagulation. The explanation lies rather in the injury of liver tissue and diminution of liver function consequent upon the biliary obstruction.

The tendency to spontaneous hæmorrhage in catarrhal jaundice is practically unknown. Alteration in the manner in which the shed blood of such patients clots is also unusual. Bleeding and abnormalities of blood coagulation in patients with acute yellow atrophy of the liver, [2, 45] hepatic cirrhosis, or extensive metastasis in the liver,[90] are not unusual. Hæmorrhages following clinical poisoning with phosphorus or chloroform in which severe liver injury may occur are well known.[58a, 86]

Following jaundice of septic origin in which hepatic necrosis obtains, bleeding may also occur.[92, 115]

Mayo-Robson,[103] Arnsberger [3] and Quenu [100] have called attention to the increased liability of patients to bleed with biliary obstruction when the obstructing mechanism is due to malignancy in the bile-ducts, over that present in patients with stone or stricture interrupting the bile flow. Quenu felt that the combination of malignancy and icterus predisposed toward hæmorrhage. Undoubtedly, the more complete biliary obstruction and consequently greater liver destruction accounts for the more frequent abnormalities

of coagulation seen in such patients. Judd and Counsellor [55] have recently demonstrated that greater dilatation of the duct system of the liver obtains in obstruction due to carcinoma, than that seen following biliary obstruction due to stone or stricture. In congenital obliteration or atresia of the bile-ducts, hæmorrhage is a frequent cause of death.[83, 120]

Petren [96] states that after operations for the relief of biliary obstruction, hæmorrhage may occur independent of age, sex, the nature of the operation performed or of the agent responsible for the block in the extra hepatic bile passages. In most instances where bleeding occurred it obtained shortly following operative intervention. In an instance reported here bleeding commenced seven days after operation. Bleeding after the first week Petren found to be unusual. Petren [96] cites a few instances, however, in which dangerous or fatal hæmorrhage occurred in patients whose jaundice had already subsided following operation.

4. *The Relation of Calcium to Bleeding.* Since calcium was recommended by Wright in 1891 for the control of hæmorrhage, its use has been adapted to a variety of conditions. Good results attending the employment of calcium have been noted in hæmorrhages from the nose and lung as well as from hemorrhoids and after childbirth. Calcium was first used in the treatment of bleeding associated with obstructive jaundice by Mayo-Robson.[103] Today it is looked to as the most dependable agent in the protection against post-operative hæmorrhage in patients with obstructive jaundice.

Wright stated that the coagulation of blood in hemophilia and in normal patients could be hastened by the administration of one gram of calcium chloride thrice daily. Boggs [4] fed rabbits calcium chloride by stomach tube and made intravenous injections with a consistent lowering of the coagulation time. Denk and Hellman [13] state that the oral administration of calcium in man increases the coagulability of the blood when the time already is normal, lower than normal, or delayed. Schmerz and Wischo [112] injected calcium lactate intravenously in 0.10 gram doses in patients with a normal blood coagulation. A shortening of the clotting time within ten minutes following the injection was regularly observed. After eleven to twelve hours the coagulation time was still decreased and only returned to the initial level after 24 hours. Maendl [77] in 1920 stated that he had treated the hæmorrhages of pulmonary tuberculosis for three years with good results by the intravenous injection of 5 to 10 c.c. of a 10 per cent. solution of calcium chloride.

Van Lier [73] and Addis [1] have been unable to increase the coagulability of the blood in hospital patients by the oral administration of calcium. Loewenstein and Politzer [74] observed no effect after giving calcium lactate by mouth, but found that the intravenous injection of calcium chloride always lowered the coagulation time even in patients in whom the blood clotted normally.

Rey [102] obtained consistent increases in the blood calcium of dogs following the subcutaneous and intravenous administration of calcium oxide. Heubner and Rona found that the blood calcium in cats increased to two to three times normal after the intravenous injection of calcium chloride. After two hours, the blood calcium was normal again. Jansen [58] has shown that the oral administration of only the soluble salts of calcium will increase the blood calcium. Calcium bicarbonate was most effective in this respect with an increase of 57.2 per cent. in the blood calcium following oral ingestion. An hour or two following the intravenous injection of calcium chloride, Jansen found the calcium level in the blood normal again.

The use of calcium as it is employed today in our country in the prophylaxis against hæmorrhage in obstructive jaundice, as well as when the coagulation is already delayed, has been brought about largely through the efforts of Walters [133, 144] of the Mayo Clinic. In 1921, following the intra-

venous injection of 5 c.c. of a 10 per cent. solution of calcium chloride, once daily on three successive days as a pre-operative measure, Walters was able to report a marked reduction in post-operative mortality from hæmorrhage in obstructive jaundice. Two years later Judd and Lyons [56] reported 143 operations on the common bile-duct with eight deaths. In none of these instances, the authors state, was hæmorrhage a factor in the cause of death. More recently Judd [54] has reported 142 operations on the common bile-duct with eleven deaths. Jaundice was present in some degree in 104 patients and in four of the eleven deaths hæmorrhage was a factor in the lethal outcome. The fact that deaths occur from spontaneous hæmorrhage in patients with biliary obstruction as well as after operation upon such patients indicates, however, that the intravenous use of calcium has not solved the problem of hæmorrhage in jaundice.

The belief that the delay in coagulation and the hæmorrhagic tendency of obstructive jaundice are due to a lack of calcium in the blood has already been referred to. That the bile acids in the blood are probably not responsible for the alteration in blood coagulation has been pointed out. It has been mentioned that the retention of bile pigments in obstructive jaundice is thought to cause a functional deficiency in calcium and to render the blood calcium less available to participate in the process of blood coagulation. An actual quantitative deficiency of the blood calcium, however, does not obtain.

In parathyroid tetany in which a quantitative diminution of blood calcium occurs, no prolongation of the clotting time nor tendency to hæmorrhage obtains. Kottman and Lidsky [66] observed an accelerated coagulability of the blood in two dogs with experimental parathyroid tetany. Simpson and Rasmussen [117] failed to observe any alteration in the coagulation of blood in experimental parathyroid tetany.

Hammarsten [50] was the first to show that in the first step in the clotting of blood, calcium was essential for the activation of prothrombin (thrombogen), into thrombin, but that the interaction of thrombin and fibrinogen to form fibrin could take place in the absence of calcium. Since then, Vines [131, 132] has found that the presence of ionized calcium is not necessary to clotting, and Stuber and Focke [124] have produced clots in the absence of calcium.

It has recently been found that following the administration of parathyroid hormone (Collip) to normal patients, or to patients with parathyroid tetany, that the blood calcium can be increased at will. Gordon and Cantarow [40] observed a consistent reduction in the clotting time following the use of parathyroid extract in patients with normal coagulation time. A change in coagulation was noted four hours after the injection and the maximum change after ten to fifteen hours. In fourteen cases of jaundice (ten obstructive) with normal blood coagulation, Cantarow, Dodek and Gordon [30] found the response to parathyroid extract injection to be similar to that observed in non-jaundiced patients. Zimmerman [149] tested the effect of the administration of parathyroid extract in large doses to normal dogs and after experimental bile-duct obstruction, as well as in normal patients and in patients with jaundice. An end-point for coagulation was used which for normal dogs was twenty-five minutes and for patients thirty minutes. Twenty-four to forty-eight hours later, when the coagulation time was again determined, Zimmerman observed no change from the initial reading.*

* Petren [99] used an end-point which for normal patients was thirty-eight to forty minutes. Delay in the extravascular clotting of blood by this method, when not marked, would appear to be demonstrated with greater certainty than by methods in which the usual end-point is eight minutes or less.

Lee and Vincent [71] state that the "calcium in vitro" test in which it is demonstrated that venous blood from jaundiced patients can be made to clot more rapidly in vitro following the addition of calcium bears evidence that there is a deficiency of available calcium in obstructive jaundice. Morawitz and Bierich [86] have also shown, however, that the same acceleration of the clotting of jaundiced blood can be brought about by the addition of tissue extract. They observed that tissue juice when added to the blood of cholemic patients in vitro caused the blood to clot three times more rapidly than normal blood.

There is, however, some evidence that would indicate a disturbance of calcium metabolism in obstructive jaundice. A number of years ago Pawlow [95] observed that dogs with complete biliary fistula frequently developed osteoporosis. The same change was later noted in patients with biliary fistula by Seidel.[116]

The loss of calcium from the body depots and the inability to assimilate fat has been described by Düttman [44] as the cause of the osteoporotic changes in bone in biliary fistula. The same loss of calcium from the body depots is said to occur in obstructive jaundice [70] and the excretion of fat in the stools is well known. King, Bigelow, and Pearce [63] found markedly lowered calcium values in the bones of dogs with obstruction of the common bile-duct. The osteoporotic changes described by Seidel in patients with biliary fistula have also been noted in patients with continued biliary obstruction.[75]

Recently Küttner [69] has reported parenchymatous hæmorrhages following operation in a patient with a biliary fistula of one and one-half years' duration. The bleeding responded promptly to calcium therapy.

Walters and Bowler [135] noted that after the intravenous injection of a given dose of calcium chloride in jaundiced dogs, that only half the increase in the blood calcium occurs that is seen following the same injection in normal dogs. The lethal dose of calcium chloride for jaundiced dogs injected intravenously was found by Walters and Bowler to be greater than for normal animals.

These facts, together with the observations of Buchbinder and Kern,[8] and of Kirk and King,[65] previously referred to, indicate that a disturbance of calcium metabolism may be present in obstructive jaundice. The relation of this disturbed calcium metabolism to the tendency of jaundiced patients to bleed, however, is not very clear, nor does it appear to be very direct. No denial of the suggestion of Schloessmann [110] that calcium may improve the liver function and thus lessen the liability to bleed in icterus, can be made in the present state of our knowledge concerning liver function and calcium metabolism.

A deficiency of calcium in the circulating blood of patients with biliary obstruction must not be inferred, however, because the intravenous injection of calcium chloride lowers the extravascular clotting time of the blood. It must be kept in mind that most investigators have observed a reduction in the coagulation time of the blood in normal people following calcium administration. Then, too, it is known that a number of other remedies injected into the organism may produce the same effect.

In 1904, Boggs [4] stated that at that time gelatin was used in Germany almost exclusively to lessen the danger of hæmorrhage. Its use as a hæmostatic agent Küster [68] says, was known to the Chinese centuries ago. It, too, like calcium has been employed with satisfaction in the treatment of hæmorrhages of many types. Kehr [57] at one time was an exponent of its use in the treatment of cholemic bleeding and reported three instances in which it was employed successfully for this purpose. Boggs [4] obtained a lowering of the coagulation time in rabbits after intravenous or subcutaneous injections of 10 to 30 c.c. of gelatine. Gebele [48] observed a hæmostatic action following the subcutaneous injection of gelatine in animals and in man only after loss of blood had already occurred. Negative results following attempts at reduction of the coagulation time in

normal animals with gelatine are reported by Sackur.[106] Zibell,[146] and Schmerz and Wischo,[113] attribute the influence of gelatine on the coagulation of blood to its calcium content. Wildegans [141] believes that the protein in the gelatine is responsible for this action.

In 1909, Von den Velden recommended the injection of 5 to 10 c.c. of a 10 to 20 per cent. solution of sodium chloride as a hæmostatic, and mentions an instance of its employment with good effect in the treatment of bleeding in hepatic cirrhosis. Its mode of action he thought to be entirely physical. He felt that an increase in the osmotic pressure of the blood occurred resulting in a dilution of the blood by tissue fluid. A decrease in the clotting time of the blood regularly followed intravenous injections of small amounts of this hypertonic solution in normal patients and animals. Later Von den Velden [130] increased this dosage to 100 c.c. of a 10 per cent. solution of sodium chloride for clinical use. Schenck [105] and Boitel [6] are inclined to believe that the beneficial action of calcium chloride in the treatment of the bleeding also occurs through this agency.

Schreiber [134] in 1913, recommended the intravenous injection of 200 c.c. of a 20 per cent. solution of glucose solution for the same purpose. Kehr [60] was a strong advocate of its employment in the treatment of hæmorrhage of obstructive jaundice.

Weil [138] has employed and recommended the subcutaneous injection of human serum and of the serum from ox-blood in the treatment of hæmorrhagic conditions. Perthes [97] during the same year stopped the bleeding following the extraction of teeth in a hæmophiliac by the injection of rabbit's blood about the bleeding surface. Quenu [100] has followed Weil's suggestion for the treatment of the hæmorrhagic diathesis of biliary obstruction and describes good results. Willy Meyer [82] has employed the subcutaneous injection of human serum in the treatment of bleeding in jaundice and has found this procedure effective.

Fonio [46] has prepared and used an extract containing the lipoids and blood platelets of blood in the treatment of bleeding of every type with satisfactory results.

In 1920,[123] after the exhibition of calcium and other hæmostatic remedies had been without result, Stephan radiated the spleen and successfully arrested hæmorrhage in a patient who had bled following the removal of a supra-clavicular lymph-node. He later observed that the blood of a normal patient clotted more quickly in vitro after radiation of the spleen.[123] Schinz [109] noted an acceleration of the extravascular clotting of blood following radiation of the spleen in normal persons but found it ineffective in the bleeding of jaundice. Tichy [127] has noted decrease of the clotting time following radiation of the liver. Szenes [125] noted a shortening of the coagulation time following radiation of a malignant tumor of the thyroid. Müller [86] states that the same effect may be obtained following radiation of any organ and attributes the mode of action to tissue destruction. Nigst [89] observed a decrease in the coagulation time after radiation of the splenic area in three patients from whom the spleen had previously been removed.

The observation of Foster and Whipple's [47] that radiation of the thorax or abdomen results in a prompt rise in the blood fibrin value is the likely explanation of the influence of radiation on blood coagulation. The tissue injury or destruction following radiation gives rise to an increased blood fibrin.

The value of blood transfusions in the treatment of all hæmorrhagic diatheses is well known and needs no special discussion here. Pendl [93] and Pallin [93] have reported instances citing its value in the treatment of bleeding accompanying biliary obstruction.

Not long ago, however, venesection was occasionally used for the control of bleeding, based on the fact that hæmorrhage is spontaneously arrested after the acute loss of a large quantity of blood.[2] Von den Velden [129] had practiced segregating the blood in the extremities for this purpose. As recently as 1910, venesection was recommended by Sahli [107] for the treatment of bleeding in hæmophilia.

Euphyllin has been found by Nonnenbruch and Szyszyka [91] to decrease the coagulation time on injection. Calcium and tissue extract if added to blood in vitro or if injected, appear to decrease the clotting time. Witte's [33] peptone has no influence on coagulation when added to blood in vitro but when injected intravenously, inhibits the clotting of

blood shed subsequently. Atropin injected into the portal circulation of the dog has the same effect but does not influence blood clotting when added in vitro. Sodium citrate inhibits clotting in vitro but may accelerate coagulation when injected into the organism. Wilkie [148] recommends its use in the treatment of bleeding of biliary obstruction.

This brief recapitulation of the usual and most effective hæmostatic remedies employed in the treatment of hæmorrhage has been made only to indicate that an increase in coagulability and a reduction in the clotting time of blood may be effected by a large number of means. A shortening of the time in which blood clots following the successful employment of a certain agent in the arrest of hæmorrhage does not necessarily indicate a deficiency in the organism of the remedy used. Decrease in the clotting time of the shed blood of patients with obstructive jaundice following the intravenous injection of calcium chloride does not signify a functional deficiency of calcium. It only means that calcium is a good remedy to reduce the prolonged extravascular clotting time of the blood in biliary obstruction.

5. *The Relation Between Delayed Coagulation and the Tendency to Bleed.*—A point that requires emphasis in the discussion of hæmorrhage in jaundice is that the entire problem does not hinge on a decreased coagulability of the blood. Mere delay in the extravascular clotting is not responsible for the spontaneous hæmorrhages that may obtain in icteric patients. Nor can prolonged bleeding from the operative wound in patients with biliary obstruction be attributed solely to delayed coagulation of blood. The problem of the arrest of hæmorrhage in vivo is not as simple as the solution of the process of clotting in vitro.

In the normal circulating blood prothrombin (thrombogen), calcium, and fibrinogen are all present. The circulating blood remains fluid because thrombokinase is present in no great amount, or because an excess of antithrombin is not present.

In the arrest of hæmorrhage following operative incision on a patient in whom no hæmorrhagic dyscrasia is present, an adequate hæmostasis is obtained by the ligature of the large vessels (arteries and veins). Spontaneous arrest of bleeding ordinarily occurs in the smaller vessels (capillaries, arteries, and venules). Following the exhibition of heat or pressure, or the local application of an astringent the hæmostasis in the lesser vessels can be accelerated. The failure of this spontaneous arrest of hæmorrhage to occur in the smaller vessels in a hæmorrhagic diathesis indicates the inadequate formation of blood platelet thrombi to occlude the vessel, or an inability of the vessel to retract properly. After division the intima of the normal vessel rolls in like the end of a glass tube exposed in a flame. Even the capillaries without muscle tissue in their walls possess an inherent power of contracting when injured.[121] Undoubtedly, this contraction of the smaller vessels is of primary importance in the control of bleeding. Stegemann [120] says that in the finer vessels thrombus formation does not occur and that the contraction of the vessel alone causes internal apposition and arrests bleeding.

In patients with purpura hæmorrhagica, an improper blood platelet thrombus formation due to the deficiency of blood platelets accounts for the tendency to bleed. A deficiency of calcium in the circulating blood has not been adequately demonstrated in any hæmorrhagic disease. In hæmophilia, no quantitative diminution of the blood platelets is present. It has been suggested that the etiological factors concerned are a qualitative change in the blood platelets and a deficiency of prothrombin.[84] In both hæmophilia and the bleeding of obstructive jaundice, a prolonged extravascular coagulation time of the blood and a tendency to bleed after trauma are present. In the hæmorrhagic dyscrasia of biliary obstruction a deficient contraction of the smaller vessels and an inadequate blood platelet thrombus formation would appear to be as much responsible for the bleeding in these patients as is the delay in the extravascular clotting of the blood. The dyscrasia does not reside in the blood alone; the blood-vessels must also be implicated.

Morawitz [86] has stressed the importance of determining the bleeding time described by Duke,[43] in hæmorrhagic conditions. He believes that its determination is much more important than that of the clotting time. He points out that the bleeding time may be prolonged when the coagulation time is normal (Purpura) but knows of no condition in which the bleeding time is normal when the coagulation of the blood is prolonged. In his hands, hæmophilia, jaundice (with a prolonged clotting time), phosphorus poisoning, and experimental hirudin injection always exhibit a prolonged bleeding time.

It would seem that in a disease in which there is a decided tendency to bleed after operative trauma as in jaundice (with prolonged coagulation) or hæmophilia that the bleeding time should also be prolonged. If the bleeding time does not determine the tendency to bleed after trauma what does it determine?

It is true that most investigators obtain a normal bleeding time in the hæmorrhagic diathesis of biliary obstruction. The bleeding time in the four patients reported here were consistently normal. In purpura hæmorrhagica, when purpura is present, the bleeding time is always prolonged. Is it that the bleeding time as it is ordinarily determined, measures only an inadequate blood platelet formation and that the plunging of a needle to a depth of about 4 mm. into tissue does not test the contractibility of the vessels?

Treatment.—The hæmorrhagic dyscrasia of obstructive jaundice is due to liver injury and diminution of liver function. Briefly stated, the treatment most urgently indicated to avoid hæmorrhage lies in the early relief of biliary obstruction.

At the present time, the best index that we have of the tendency of jaundiced patients to bleed is the coagulation time of the blood. The tendency to bleed and delay in the extravascular clotting of blood, however, do not always run parallel. That post-operative bleeding may obtain despite reduction of the coagulation time is well known. An unoperated patient referred to in this report died suddenly from extensive hæmorrhage into the entire intestinal tract when the clotting time determined on the same day was normal.

That the tendency to hæmorrhage and delay in the clotting of blood in patients with biliary obstruction may remain refractory to all methods of treatment is illustrated in the histories of two of the patients related here. When both delay in coagulation and the tendency to spontaneous bleeding are present, conservative means of treatment are less effective than when delay in clotting alone is the only stigma of an abnormal hæmostasis. Elsewhere,[138] the writer has reported the instance of a patient with profound jaundice of three and one-half years' duration, in which no tendency to spontaneous hemorrhage had been manifested. A clotting time of fifty minutes was reduced to an almost normal reading after calcium administration and transfusions. No bile-ducts could be demonstrated at operation and the patient died five days later. No tendency to bleed was manifested, nor were any hæmorrhages found at the postmortem examination.

At the University Hospital, calcium chloride has been given pre-operatively to all patients with obstructive jaundice as outlined by Walters, for several years. When the clotting of the venous blood of jaundiced patients is delayed, we have found the intravenous injection of calcium chloride to be more effective in the reduction of the delayed coagulation than other remedies. But when hæmorrhages occur post-operatively, we have cause to rely more on the transfusion of unmodified blood by the Kimpton-Brown tube method than on other measures. Anything that improves liver function may have a favorable influence on the tendency to bleed. W. J. Mayo[81] has emphasized the value of the administration of glucose to patients with hepatic insufficiency. After hepatectomy in dogs, Mann and his associates[80] have been able to prolong the period of survival for several hours following the intravenous injection of glucose. The value of hypertonic solution of glucose as a hemostatic agent has already been referred to.

What is to be done with the patient whose delay in coagulation remains refractory to all the conservative means of treatment? It is stated that to operate in the presence of a persistently delayed coagulation is only to invite disaster.[67, 111] In hæmophilia, patients have a recurring cycle in which the tendency to bleed after trauma is increased. In some phases of the cycle, the coagulation time may be normal, and the patient may manifest little or no tendency to bleed. In obstructive jaundice, in which the factor of biliary obstruction continues to operate, it is not likely in the presence of complete obstruction that the hæmorrhagic diathesis may become automatically adjusted, as McVicar and Fitts[76] have suggested. Postponement of the relief of biliary obstruction after transfusion and calcium have failed to bring about a normal blood coagulation, only permits the vicious cycle to become worse. When it can be demonstrated that the obstruction is incomplete, delay may have some virtue. But to continue with conservative measures, when a fair trial has been of no avail in the reduction of delayed clotting, is procrastination that increases the liability to hemorrhage when operation is performed.

Those who withhold from operating on patients with complete biliary obstruction with a persistent delay in the coagulation of the blood point to the

enormous mortality of operating for the relief of obstructive jaundice due to malignancy. Without operation, however, the outcome is not long delayed and the mortality is always 100 per cent.

In one of the instances reported here operation was withheld because of the ascites, the delayed coagulation of the blood and spontaneous tendency to hæmorrhage. The operative risk in such a patient, of course, would have been great (75 per cent. in the light of compiled statistics [58b]) but the post-mortem findings certainly indicated that an operative attempt would have been worth while. A small localized carcinoma of the bile-duct was found at the point of union of cystic and hepatic ducts. The ascites was due to biliary obstruction. No metastases were demonstrated.

It is known that a patient may first exhibit the tendency to hæmorrhage after the drainage of bile has been established. One such instance is reported here but fortunately the outcome was favorable after repeated transfusions. Petren [98] reports fatal instances that bled only after drainage had been effected for several days. Such an occurrence suggests that the sudden release of the biliary obstruction may temporarily increase liver damage, diminish liver function, through œdema or other cause, and increase the liability to hæmorrhage. The danger of sudden decompression of the distended urinary bladder following chronic retention of urine is, of course, well known. Crile [12] and Reid [101] have already suggested for other reasons gradual decompression of biliary obstruction in chronic icterus. Reid believes that a "serious toxic state" may occasionally occur after the sudden decompression of the common bile-duct of deeply jaundiced patients.

That the important factor in the avoidance of hæmorrhage in patients with biliary obstruction lies in the early relief of the obstruction cannot receive too much emphasis. The greater number of patients needing surgery for the relief of obstructive jaundice come to operation when the block in the bile flow has been present for many weeks and even months. Rovsing [104] stated that in unremitting obstructive jaundice of two to three weeks' duration the patient should be submitted to operation at once. Schmieden and Sebening [113] believe that when biliary obstruction has been complete for more than two weeks and delay in coagulation is present that conservative means are of no value in its treatment. Kehr [61] stated that when biliary obstruction has been present for more than five or six weeks, operation, because of the danger of hæmorrhage, carries an extremely high and unnecessary risk.

When catarrhal jaundice, which occasionally occurs even at the time of life when operations for the relief of biliary obstruction are common, can be ruled out by a short period of observation, certainly operation should not be deferred, in the presence of increasing jaundice.

In a patient in whom the jaundice is due to cholangitis, a simple decompression operation as advised by Crile [12] would appear to be the operation of choice. When the obstruction is due to a stone in the common bile-duct and can readily be removed, this should be done, but the removal of the gall-bladder even though stone-containing or diseased should be deferred to a later date. Unnecessary operating is to be avoided.

In patients in whom a carcinoma of the pancreas is found (or a chronic pancreatitis causing jaundice, a rare occurrence) a cholecysto-duodenostomy is to be performed. When a carcinoma of the bile-ducts is present and excision of the tumor feasible, a hepatico-duodenostomy or an anastomosis employing the gall-bladder should be done. A simple drainage operation (cholecystostomy) in the cases of duct malignancy carries the same mortality as an anastomosis operation, and these patients stand a complete external biliary fistula poorly.

The choice of a suitable anæsthetic agent in the presence of chronic icterus is very important. The avoidance of chloroform needs no emphasis. The occasional occurrence of anuria after operation on jaundiced patients under ether has prejudiced the writer against its use. It is known, of course, that anuria may obtain in the course of obstructive jaundice, in unoperated patients and it may be that the operation itself is as much responsible for the complication of anuria as is the anæsthesia. But when possible, the operation should be done without ether. The preliminary injection of morphine combined with novocaine anæsthesia of the abdominal wall and the administration of nitrous-oxide anæsthesia usually gives sufficient relaxation. An adequate incision gives good exposure and expedites the surgical procedure.

SUMMARY AND CONCLUSIONS

The histories of two unoperated patients who died with spontaneous hæmorrhages due to biliary obstruction, are reviewed. The instance of another patient is recorded in which fatal bleeding followed the excision of a stricture and reconstruction of the common bile-duct. Another instance is reported in which the patient almost lost his life through the agency of parenchymatous hæmorrhage, when no dyscrasia of coagulation could be demonstrated preoperatively.

It is pointed out that the retention of bile in the organism *per se* is probably not responsible for the hæmorrhage diathesis of obstructive jaundice. The destruction of liver tissue and the diminution of liver function, consequent upon the biliary obstruction, would appear to be the chief etiologic factors.

The tendency to bleed exhibited by patients with obstructive jaundice does not depend on delay in the extravascular clotting of the blood alone. The blood-vessels as well as the blood itself in this respect are abnormal.

The important principle in the avoidance of hæmorrhage lies in the early relief of biliary obstruction. In the reduction of delayed coagulability, the intravenous injection of calcium chloride is the most dependable agent. In the treatment of parenchymatous hæmorrhage, after operation, the transfusion of unmodified blood is of most value. In instances of unremitting jaundice in which the delayed clotting remains refractory to all the conservative methods of reduction in the absence of other contraindications, biliary decompression should be done at once.

Hæmorrhage following operation for the relief of biliary obstruction is still an important cause of operative mortality.

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BENIGN TUMORS OF THE STOMACH*

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and

Maurice F. Dwyer, M.D.

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Benign tumors of the stomach are not common. In four thousand röntgenological and clinical examinations of the stomach in our clinic since 1920, only three have been found. Besides the benign tumors one gastric hair-ball was encountered. On account of the relative infrequency of benign lesions, we have considered it of sufficient interest to report and discuss each case emphasizing a few points in diagnosis and surgical technic.

These cases have taught us that one must continually bear in mind that a benign gastric tumor although rare, may be the cause of an atypical gastro-intestinal complaint or an unexplained chronic anemia. Eusterman has shown that less than one-half of one per cent. of gastric neoplasms are benign. Balfour and Henderson report a series of fifty-eight cases of benign tumors of the stomach encountered at operation. Braun and Pearl report five proven and seven probable cases of diffuse gastric polyposis.

Benign tumors of the stomach are briefly classified as papillomata, myomata, adenomata, fibromata, lipomata, osteomata, cysts and adeno-papillomata, the latter commonly called polyposis.

Case I.—Seen in consultation with Dr. W. A. Taylor, Ellensburg, Washington, November, 1920. Mrs. H. A., age thirty-five, consulted Doctor Taylor in August, 1920, on account of severe gastric hæmorrhage. The patient was hospitalized for ten days during which time two transfusions were given. Röntgenologic examination of the stomach and duodenum was said to be negative. Gastric acidity was slightly above normal.

Ten days after leaving the hospital another gastric hæmorrhage occurred. She returned to the hospital and sixteen transfusions were given, endeavoring to get her in condition for operation. During this stay in the hospital a smooth tumor could be palpated in the upper left abdomen. At operation Doctor Taylor found a pedunculated tumor about the size of a grape fruit attached by a small pedicle to the posterior wall of the stomach.

Microscopic study of the tumor was made by two pathologists and both reported "spindle-celled sarcoma". The patient, however, has been free from gastric symptoms since the operation seven years ago, and reconsideration by the pathologists has classified the tumor as a leiomyoma.

Case II.—24747. W. W., male, age forty-eight, came to clinic July 25, 1927, complaining of severe diarrhœa.

Clinical History.—Well as a boy, graduated from college in 1901; from then until 1909, lived as a bachelor and much of the time did his own cooking. The diarrhœa from which he now seeks relief began in 1902, and since then it has bothered him each year, although he states that he does not believe that the severity of the attacks of diarrhœa

* Read before the Western Surgical Association, December 8, 1927.

have been as severe since 1910 as they were previous to that time and attributes this to the more careful selection of his diet.

In 1903, the patient had an attack of indefinite upper abdominal distress associated with jaundice and fifteen to twenty bowel movements a day. The diarrhœa was not painful, no blood was seen, but he passed considerable mucus. The patient believes that these attacks of diarrhœa are often precipitated by nervousness.

In 1924, the gall-bladder was removed and the patient believes that the bowels have caused him less trouble since then until the past six months. In October, 1924, a rather marked pigmentation appeared on the hand and on account of this glove pigmentation associated with diarrhœa a diagnosis of pellagra was made in California.

In September, 1926, he weighed 175 pounds. In February, 1927, he suffered from influenza and considered himself too busy to allow sufficient time for convalescence. In May he began to have another severe attack of diarrhœa. He was examined clinically and röntgenologically by his family physician who found no trouble in the stomach. He was placed on frequent feedings of eggs, meat, vegetables and orange juice. There was some improvement and he went to a resort to convalesce, and while there his diarrhœa recurred.

On arriving in Seattle last July, his condition was so critical that he immediately went to a hospital.

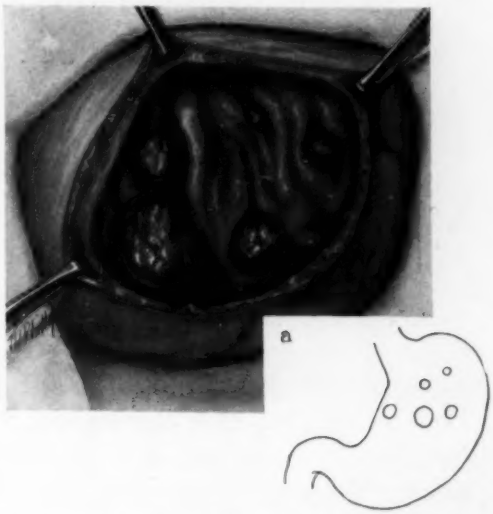

FIG. 1.—Case II. Showing polyposes on the posterior wall of the stomach. a. Showing size and location.

Röntgenological examination of the stomach showed three small tumors in the posterior upper third of the stomach. The technic used to demonstrate the lesions will be discussed later. Examination of the colon by means of the barium enema was negative. Several stool examinations failed to reveal any definite abnormal findings and proctoscopic examination was considered negative.

On July 30, 1927, the patient was operated on by Doctor Mason. The stomach was opened by a midline incision. Five polyps were seen. Three had been detected by the X-ray, one about the size of a lemon and two about the size of a cherry. The remaining two were about the size of a cherry seed.

Pathological examination of the polyps showed each to be a very vascular mucus polyp covered by a single layer of gastric mucosa. The underlying tissue was mucoid in character, similar to that seen in a nasal polyp, definitely a benign tumor.

Convalescence was remarkably uneventful and there has been no recurrence of the diarrhœa to date.

CASE III.—W. J. W., 25675, age sixty-seven.

Personal History.—He states that with the exception of a chronic constipation of many years' duration he has always enjoyed good health.

Clinical History.—Well until October, 1926, when he lost his taste and appetite which have never returned. At that time he weighed 178 pounds. During the past year he lost sixty pounds in weight and consulted a physician then on account of loss of weight and weakness in his legs. During September, he began to complain of pain in the lower abdomen—"felt like he was full of gas". During September and October, he occasionally felt nauseated and vomited a few times and had two rather severe attacks of diarrhœa

one lasting three days, the other seven. Considerable amount of blood was passed, once during the latter attack of diarrhœa.

During the past year he has been troubled with frequency of urination, often urinating ten times during the night. Urinalysis was negative. Red blood cells, 3,130,000; leucocytes 14,000, hæmoglobin 48 per cent.

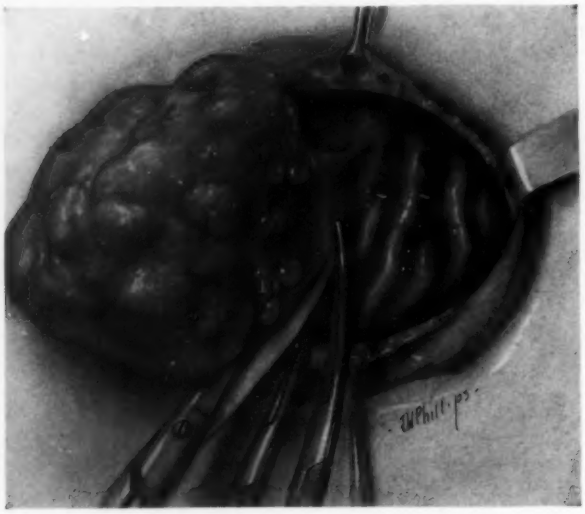

FIG. 2.—Case III. Large single pedunculated polyp.

Physical Examination.—Considerable emaciation. Head, neck and chest negative. Abdominal mass size of an orange palpable in epigastrium. On account of emaciation, the mass at this date was easily felt.

Operative Findings.—On opening the stomach a large pedunculated tumor about size of an orange was found attached to the posterior wall. On account of its marked irregularity and cauliflower appearance it was thought to be either an adenoma or a carcinomatous degeneration of the adenoma. Microscopic examination shows a marked irregularity of the surface but no evidence of carcinoma. The mass itself is definitely a fibro-myoma with marked inflammatory changes.

Operative Technic.—The operative technic for benign tumors of the stomach is very simple. In each case a small transverse incision was made in an avascular surface of the stomach. These incisions were enlarged to three times their size by gentle retraction with small retractors. We feel that this is probably one of the most important steps in the operation. One of these patients received gas and ether inhalations, one gas and local anæsthetic, and one local anæsthetic only. The post-operative convalescence was practically the same. In approaching the benign tumors hæmostats were applied to the base being attached well on the side of healthy mucous membrane. The tumors were removed with a long pair of curved scissors and an actual cautery applied to the base above the hæmostat. The cautery was held on the blade of the hæmostat until we felt that that instrument had received enough heat to coagulate the tissues and blood-vessels to the immediate tissues. The grasping area of the hæmostat was then whipped over with a running suture of double dulox. The hæmostat being

FIG. 3.—Cross-section of the tumor.

loosened and slipped out of place before the suture was pulled taut. Over this approximation several interrupted wax sutures were placed.

SUMMARY

In reviewing these three cases of benign tumors of the stomach, one is impressed by the lack of any gastric symptoms. All complained of weakness, anemia and loss of weight but none attributed their ill health to a lesion in the stomach. Diarrhœa was very persistent in one case and was practically the sole complaint.

The most important means in the diagnosis of these cases was the röntgenologic examination. All the tumors found in these three cases were located on the posterior wall of the stomach. The method now used to demonstrate lesions located on the posterior wall, is one of the many things to which röntgenologists shall always be grateful to Dr. Russel D. Carman. Carman in 1923 presented a newer method of demonstrating lesions located on the posterior wall, especially those situated in the upper third of the stomach. These cases have taught us to never omit the method from our routine. It was formerly our practice after following the barium mixture through the œsophagus to centre our attention on the duodenum, because the duodenal cap is frequently well visualized after the first few swallows of the liquid. Now observation is made to determine the course of the barium stream as it descends in the stomach. Normally the stream follows a direct course in the upper part of the stomach until it impinges on the gastric wall and then descends as the stomach relaxes before it. If a growth is present high on the posterior gastric wall the barium stream will be deflected to one side or the other or if the mass is comparatively small the stream may be divided. When the stomach is partially filled with the barium suspension, careful palpation approximating the gastric walls will project the fluid about the viscus in a thin layer, and will show a filling defect on the posterior wall which could not be seen otherwise. These growths are not seen if enough media is in the stomach to completely submerge them. During the manipulation of the partially filled stomach attention should be directed to the parallel streaks representing the sulci between the rugæ of the stomach. These rugæ are obliterated in the area of the tumor.

The value of careful palpation of the partially filled stomach during fluoroscopy cannot be emphasized too strongly. It is our opinion that if this is made a routine procedure, we will not have an occasional report of a benign gastric lesion but probably many of them within the next few years.

FASCIAL SUTURES FOR INGUINAL HERNIA*

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The object of this paper is to give the clinical results obtained in the employment of autoplastic fascial sutures in the treatment of inguinal hernia in the male.

We will not go into the pros and cons of the experimental question whether fascia does or does not readily unite with muscle. We are simply endeavoring to find out whether we can obtain better clinical results with living fascial sutures than with catgut. We wish to emphasize the following facts. This is a preliminary report based on a relatively small number of cases. Living fascia is apparently a reliable suture material but is only to be considered as an adjunct to sound hernial surgery.

We have employed fascial sutures for five and one-half years. At first we used the Gallie method exclusively, reserving it for the severe herniæ. As we gained more confidence in the fascial suture we made a tentative trial of the McArthur method. Two years ago we adopted it for our routine cases; to a limited extent it is used by my associates.

Fascial Methods Employed.—In this series we reserved the Gallie method of free fascial sutures for the large direct and recurrent herniæ, adhering closely to the technic described by Gallie.

In the first forty cases in which McArthur autoplastic pedicle fascial flaps were employed we followed the technic as laid down by McArthur. In the remaining cases we employed the mesial fascial strip to unite the conjoined tendon to Poupart's ligament, and omitted the use of the external strip to unite the cut edges of the external oblique. We proceeded on the assumption that fascia unites to fascia more readily than to muscle and used chromic gut for this union. On several occasions we have been embarrassed for the want of sufficient fascia to cover the cord. It was on account of this difficulty that we fell into the error of employing the easier method of bringing the cord external to the external oblique. This error we have sincerely regretted. With the exception of this modification and the occasional tacking down of the fascial suture with chromic catgut, we have adhered to the technic described by McArthur.

Operations Employed.—Two types of operations were employed in this series, the standard Bassini repair and the Halstead modification. After a fair trial the Halstead modification was abandoned as it violated the essential physiological principle of muscular shutter closure. In our hands the Bassini repair has given better clinical results. So far all the recurrences in this series, with the exception of one, have been in patients operated on by the Halstead method.

* Read before the New York Surgical Society, March 28, 1928.

We have not employed the rectus transplant or any of its variants believing that these procedures are physiologically and anatomically unsound.

In all operations we strive to carry out the following principles:

1. Excision and high ligation of the sac, fixation of the sac well above and out of line with the internal abdominal ring.

2. A high closure of the internal ring about the cord paying particular attention to the suturing of the transversalis fascia well up behind the cord.

3. In suturing the conjoined tendon to Poupart's ligament, we pass the continuous fascial suture in such a manner that the conjoined tendon is shortened and its insertion into the pubic spine strengthened. With the same suture, the arc of the arched fibres of the internal oblique is sutured low down on the mesial and posterior aspect of the cord. This combined with a high suture of the transversalis fascia lengthens the canal, separates the internal from the external opening, converting the pathological canal into one which more nearly approaches the normal. The defensive muscular mechanism of the reconstructed canal, when tested by voluntary and electrical stimulation, shows a very efficient functional shutter closure.

4. Immediately upon the completion of the stage of dissection the patient is placed in the position of physiological relaxation. In this position the gap between Poupart's ligament and the conjoined tendon is obliterated or materially reduced and a low muscular suture can be inserted without tension.†

5. In order to insure a permanent union between the structures to be united, it is essential to remove not only the loose gliding areolar tissue from the fascial strips but also to clear Poupart's ligament.

6. The needle should be large enough to allow the fascia to be pulled through without dragging. A ligature is tied to the fascial suture and its ends passed through the eye of the needle. It will be found that this method of attaching the suture to the needle is simple, less wasteful and the suturing smoother.

After-care.—Careful instruction regarding the protection of the wound during coughing, straining, etc., should be given. After the period of convalescence has been passed, massage and systematic exercises to strengthen the abdominal muscles and improve the muscular control of the inguinal region should be insisted on.

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† To obtain this position the thigh is flexed on the abdomen, and the leg on the operative side is crossed over the opposite one. This relaxes Poupart's ligament which in turn automatically relaxes the internal oblique, transversalis and conjoined tendon. Further relaxation can be obtained by flexing the thorax on the abdomen which relieves the tension on the external oblique, the rectus and the conjoined tendon. The patient is returned to the ward in this position, the leg uncrossed and the patient put to bed in the position of relaxation. This position is maintained throughout convalescence. The position of physiological relaxation has been used for eighteen years and is considered as essential in the treatment of hernia as physiological balance and muscular relaxation is in the reduction of fractures.

Results.—To date the fascial suture has been employed in 335 herniæ, 159 of these have been followed from eighteen months to five and one-half years. The average follow-up report covers two years. The patients have been examined by one or more members of the surgical staff. All patients are males of eighteen years or over, the oldest was sixty-five, the average forty-two and five-tenths years; 75 per cent. were laborers. Follow-up reports by letter are excluded. There were 132 McArthurs and twenty-seven Gallies.

In 101 operations for indirect herniæ there were three recurrences—3 per cent.

In fifty-four operations for direct herniæ there were five recurrences—9.5 per cent.

In four operations for direct indirect herniæ there were no recurrences. That is in a total of 159 cases there were eight recurrences 5 per cent. During the same period there were 271 herniæ operations repaired by catgut. In 200 indirect herniæ there were eighteen recurrences (9 per cent.), in seventy-one direct herniæ there were ten recurrences 14 per cent. That is with catgut suture there was a recurrence of 10.3 per cent. and with fascial sutures 5 per cent. Three important factors are to be kept in mind in comparing these figures. Before the adoption of the fascial suture as a routine we had limited it to the severe herniæ; the fascial suture was a new method requiring experience and a new technic, several operators had to get their experience. In future it is reasonable to expect that we may obtain a higher per cent. of cures.

Infections.—There were five infections of the hernial wounds in 159 cases 3.1 per cent., and one in the fascia of the thigh. Two of the recurrences can be directly charged to infection, the remaining three cases, which were infected, show no sign of recurrence.

Recurrences.—There were eight recurrences in this series, seven of these occurred in the Halstead modification of Bassini operation, the remaining one in the Bassini. Five occurred in direct herniæ, three in indirect. There were no recurrences after the Gallie operation. Two of the cases can be directly charged to infection, a third to a mistake in judgment of employing McArthur in a large sliding hernia when a Gallie should have been used. This case subsequently repaired by the latter method and has held. Of the five remaining patients four have been operated on, three of these had recurrences protruding directly from the internal to the external ring. In these patients the cord had been brought anterior to the external oblique fascia. The musculature was firmly united to Poupart's ligament and the fascial sutures were in place. Microscopical examination showed them to be composed of living fibrous tissue.

Other Data.—The oblique hernia represented 62.9 per cent. of the cases, the direct 37.1 per cent. There were thirty-eight bilateral herniæ 68 per cent. of which were direct, and nineteen recurrent cases. One case had been operated on three times, three cases twice. The high proportion of direct and recurrent cases operated on, is due to the fact that in the early part of this series, these were the only cases in which the fascial suture was employed.

SUMMARY

1. The fascial suture is still on trial.

2. The fascial suture lives and unites with muscle.

3. In this series the fascial suture has given much better results than catgut.

4. The Gallie method is indicated in the difficult herniæ and by its use the field of operability can be widened to include cases which we formerly believed inoperable.

5. The future progress in hernial surgery will be along physiological lines, and the problem will solve itself when we can establish as an efficient muscular mechanism as the one which guards the normal inguinal canal.

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FURTHER EXPERIENCES WITH PURELY FASCIAL HERNIOTOMY

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In August, 1924, I described in this Journal a technic for closing inguinal hernias, utilizing only white fascia.[1] Since that time I have used an identical or similar technic in all my cases and am more firmly convinced of the value of the principle. While the experimental work of Koontz[2] and Rosenblatt and Cooksey[3] have not entirely agreed with the reports of Seelig[4] on the possibility of muscle fascia union, it is nevertheless obvious that this can never be as firm as fascia-to-fascia stitching. This principle is so well recognized in abdominal surgery as a whole that practically the entire strain is supposed to be taken up by the connective tissue layers, and few if any muscular stitches are inserted in closing most laparotomies.

In doing about three hundred and fifty herniotomies, the most important lesson I have learned is that no one type of operation can or should be applied in all cases. Every hernia is a problem of its own, and the surgeon should open the inguinal canal prepared to undertake that plastic procedure which will best fit the case. I feel strongly that a great deal of our failures in herniotomy have been due to too much surgery rather than to too little surgery. It is a very striking thing that in every series of recurrences, recurrence takes place in the majority of cases at the pubic end of the canal and not at the internal ring where the hernia was in the first place. It is only fair to ask by what right we call these recurrences. There was no hernia in this position before, and I believe that we are actually causing hernias to appear in the lower end of the canal by too much stitching of layers which are intact, and have up to date prevented any herniation at that point.

For these reasons I have been doing an increasingly high percentage of cases by the simple removal of the sac, sometimes with a stitch or two in the endo-abdominal fascia to tighten up the internal ring, and closing the canal without any more surgery. This operation, to my mind, is sufficient in most hernias in young children and in a moderate percentage of recently acquired hernias in adults. In such cases the peritoneally lined sac is the only real pathology. The canal is intact. The muscular and aponeurotic structures have not been stretched or torn by prolonged tension of a hernia and the internal ring is little if any enlarged. If one is careful to dissect the neck of the sac very high into the abdomen, a mere transfixion and ligature will often include the edges of the internal ring; and the closure of this hole is

quite sufficient guarantee against recurrence of a hernia of this type. In such cases I believe that attempts to close the lower end of the canal by dragging fascial or muscular structures down to Poupart's ligament under extreme tension often is worse than futile. There is no hernia in this region at the time of the operation, but statistics show that operation is frequently followed by hernia in the lower end of the canal. It seems a perfectly justifiable conclusion that these hernias are caused by cutting through of stitches which are placed in a misguided attempt to approximate the structures which do not belong together. The stitches therefore cut through and leave holes in the floor of the canal through which the so-called recurrent hernias emerge. About 30 per cent. of my cases have been treated by some such method as this. (Sac removal alone.)

It is a disgrace to surgery that this type of herniotomy cannot be done in 100 per cent. of cases. I am very sure that if every patient was operated upon immediately after the onset of his hernia that this would be applicable always, and that our recurrence rate would be practically nil.

Unfortunately, however, hernia sufferers are allowed to fool about with trusses for so long before they come to the surgeon that serious injury to the abdominal wall has been produced. Why such a serious lesion as the protrusion of the intestines under the skin should, in the majority of cases, be treated by drug store clerks or mail order houses is very difficult to understand. The entire modern conception of a hernia with the invariable etiology of a performed sac is surely a cogent argument for early operation. Nevertheless, both medical and lay public health organizations seem to be completely oblivious to the necessity of getting hernias operated on before the structures of the lower abdominal wall have been irreparably destroyed. It should be the duty of all medical men to present the facts to the sufferer of hernia in the following light: that he has to choose between operation and truss management. If operation is ever contemplated, it should be done at once and not after a number of months of trauma by both the truss and the hernia to important muscular and aponeurotic structures. In the first few months the cure of hernia is easy and after many years it is far from easy, as can be easily proven by a study of the recurrence rates.

In old hernias we find the following marked changes about the canal:

1. A very constant finding is the atrophy of the lower fibres of the conjoined tendon so that it lies a long way from Poupart's ligament. It no longer inserts onto the pubic bone, but inserts onto the rectus sheath so that a wide triangular hole is left.

2. The endo-abdominal fascia is stretched and thin, as it is the only structure lying between the peritoneum and the external oblique aponeurosis.

Therefore the problem that confronts the surgeon is not simply the removal of a small sac but the removal of a large sac, involving considerable trauma to the cord and the closure of a large defect in the abdominal wall. In such cases the ideal procedure would be to bring the conjoined tendon down to Poupart's ligament below the cord as described by Bassini. Unfor-

tunately, however, in only about 30 per cent. of cases is this possible. In the remaining 60 or 70 per cent. the white fibres in the conjoined tendon have disappeared and the canal is lined by soft, flabby red muscle in its upper border. This muscle may lie as much as two inches from Poupart's ligament when the canal is opened, and virtually always over an inch, and can only be approximated to Poupart's ligament to build a floor of the canal by the application of extreme tension. In the minority of cases in which the conjoined tendon is intact it is so far away from Poupart's that it can be brought down by very tight stitching. For this reason I have abandoned the use of the conjoined tendon suture in about 90 per cent. of cases, and prefer to use the almost equally strong and much more movable endo-abdominal fascia. This fascia in hernia sufferers is as a rule very lax and very thin in the floor of the inguinal canal, and for that reason has been much neglected as a material to help our closure. However, if the conjoined tendon and internal oblique are bluntly dissected loose from their attachment and raised with retractors, one can pull down into the canal this endo-abdominal fascia from higher up. It is very elastic and can be drawn down like a shutter for one or two inches without the slightest tension. It has no muscular attachment and therefore does not tend to move with respiration and bodily movements. If this structure is brought down and sutured to Poupart's ligament for the entire length of the canal, we have built a floor for the inguinal region which should preclude any possibility of recurrence. After this has been done I make it a rule to put in one final interrupted stitch in the internal ring so that it will barely admit the tip of the little finger.

Further surgery is a problem of choice. In about half of the cases the gap in the fascia is so large that I reinforce it with the upper fragment of the external oblique aponeurosis exactly as described in the ANNALS OF SURGERY four years ago. In about half the cases, however, the floor of the canal appears so strong after the suture of the fascia alone that I have entirely omitted the Andrews' imbrication principle and simply closed the external oblique with a running stitch.

The immediate results of this type of surgery have been very gratifying. The most striking point is the marked lessening of pain in contrast to that of the Bassini or Andrews operation. The fascial layers are practically insensitive, but when one sews the fleshy muscles the stitches are bound to include a number of small nerve fibres, and anatomical studies show us very clearly that the lower border of the internal oblique muscles are very liable to contain large branches of iliohypogastric nerves. These will, of course, be entirely avoided by the technic described. On account of the relative insensibility of the parts sutured there has been correspondingly a very strikingly low incidence of the usual post-operative complications of hernia. Abdominal distention and retention of urine are practically no longer seen in our clinics since we have abandoned the suture of muscles and tendons under great tension.

Unfortunately I am not in position to present any large array of follow-up

statistics, the only real method of judging the value of any operation. In place of this, however, I have succeeded in getting reports or examinations on forty-three cases of unusually difficult hernias in which it is well known that the recurrence rate is very high. These include:

Four hernia permagnæ (all with swelling as large as a child's head).

One epileptic with convulsions almost daily. (Operated on account of repeated strangulations.)

Two large sliding hernias, both of the cæcum.

Two strangulated hernias in which extensive drainage of frankly infected wounds was needed.

Two hernias in old asthmatics. (Operated because of repeated strangulations.)

Three large recurrent hernias. (Two operated twice before.)

One incarcerated hernia in a three-months' pregnant woman. (Later went to term.)

Twenty-nine direct hernias.

In the direct hernias it is the consensus of opinion that the recurrence rate is about 25 per cent., and they were the most favorable of the collection.

The average age of the series was fifty-eight.

Six had albumen in the urine, two were mild diabetics, one had a myocardial disease of great severity, and was operated upon because of repeated attacks of strangulation which threatened his life.

Ten were operated under local and forty-three under general anæsthesia.

Of those here tabulated thirty-five were examined by me and nine were reported on from examinations by other physicians.

Of this collection of difficult cases there were but four recurrences in a period averaging from ten months to four years. The average post-operative time was one year and ten months.

The failures may be tabulated as follows:

One developed extensive ascites within four months (the myocardial case) and had a large double recurrence.

One asthmatic recurred on one side after six months.

One had an extensive double recurrence after an uncomplicated direct hernia operation.

One remained well for three months and was brought into the hospital unconscious, after a taxicab accident. It was his third recurrence. I had examined him three days before his accident and found him normal.

This recurrence rate (9.3 per cent.) I believe shows a distinct superiority for this fascial type of operation.

I do not believe that any particular technic is of as much importance as the principle of closing the internal ring at its highest possible point by the use of fascial stitches. In no other laparotomy would one dream of omitting this stage of the operation, and this is just exactly what is omitted in many methods of herniotomy. The experiences of LaRoque,[5] Seelig,[6] Pitzman,[7] Connell,[8] and many others have borne out this fact.

Carrying this principle to its logical conclusion, McArthur's autoplastic suture, recently revived by Gallie, would seem ideal. The only drawback to this method is this difficulty: In my hands, at least, I have generally had to take about twice as long using autoplastic sutures. The pioneer work of Henry Marc, I believe, showed without a doubt that kangaroo acts almost like fascial graft. A recent article of Koontz[9] also suggests that dead fascia will work practically as well as live fascia, and for these reasons I have continued to use kangaroo tendon in the closure of these cases.

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THE INTERNAL FIXATION OF FRACTURES AND DISLOCATIONS BY USE OF THE HUMAN FASCIAL SUTURE

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During the open reduction of certain types of bone and joint injuries some form of internal fixation is often necessary. For this purpose various materials have been used and various methods[1] have been devised—such

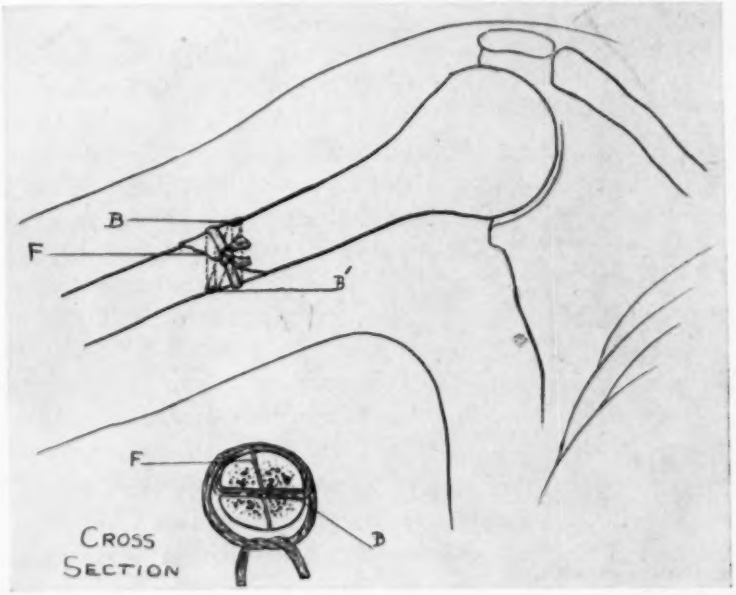

Fig. 1.—Non-union of right humerus. Fractured ends approximated. Fascial suture passed through drill holes at points B—B'—the suture being crossed behind and tied in front. The insert shows a cross-section of the suture B through the drill holes at the site of the fracture F.

as the bone plate, the bone graft, wire, steel nails, bone peg, ivory peg, screws and various other methods, including the use of kangaroo tendon and chromic catgut.

Some of these methods are adaptable to individual cases, but it is generally agreed that where the strain is at all considerable, kangaroo tendon and chromic catgut soften and break; foreign materials of metal, having done their duty, should be removed by a second operation; the bone graft adds time to the operation and often breaks or fails to function properly.

Because the fascial suture has shown such strength when used in other parts of the body, in particular about the knee-joint[2] and the abdominal wall,[3] we decided to use this suture as a method of internal fixation in certain bone

and joint cases to which we thought it applicable. This has undoubtedly been done before in isolated cases, but we have seen no group of such cases reported. We have done fourteen cases thus far and in all excellent results have been obtained. In each case at least one other method of treatment had been tried and found unsatisfactory. We will not present any argument as to whether or not open operation and internal fixation were the only things to do in these cases. All we wish to show is that the fascial suture was used in each case and it seemed to exactly accomplish its purpose, namely—hold the bones, along with external bandages, until union began to take place.

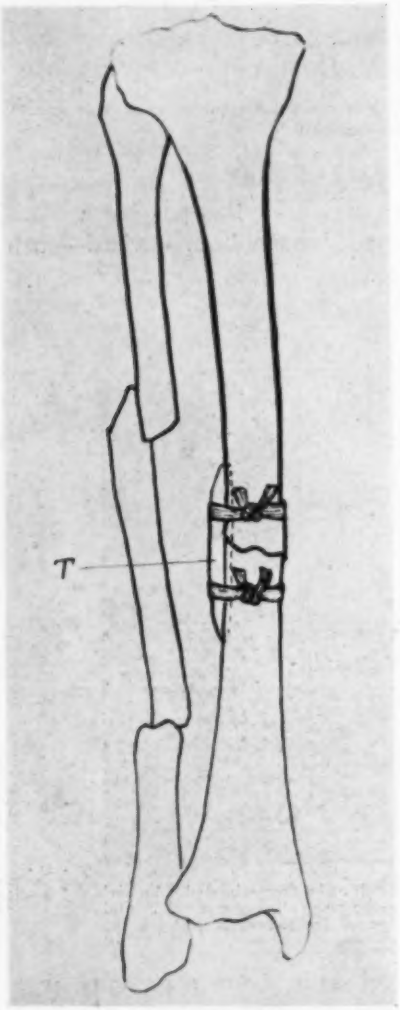

FIG. 2.—Fracture of both bones of the right leg with a large fragment of loose bone (T). Fracture of tibia reduced. Fascial sutures applied so as to hold third fragment (T), acting somewhat as a bone graft.

The end result of the fascial suture itself is naturally an interesting point. There is much in the literature about the transplantation of fascia to soft parts,[4] and about the functioning of fascia when used about joints, but we have not come across data on actual cases or on animals regarding the final change fascia undergoes when transplanted and sutured through the ends of a fractured bone. This we hope to do experimentally and report at a later date.

There has been some serous exudate at the site of the operative wound in four of the fourteen cases. Whether this is due to slight infection or the poor vitality of fascia sutured in bone, we do not know, but the wounds all healed well finally, and the delay in healing has in no case been serious.

The drawings are from actual cases. They are diagrammatic. It was thought that these drawings would be more illuminating than the X-ray prints. We have used this method on the Cornell Division at Bellevue Hospital, and the Third Surgical Division at the Hospital for Ruptured and Crippled.

A description of five cases illustrating the method follows:

CASE I.—(Fig. 1.)—Patient, C. G., age twenty years. An un-united fracture of the right humerus, junction of middle and upper thirds. This was the result of an old compound fracture, the injury occurring on Thanksgiving Day, 1925. At the time of

operation the skin and soft parts had been healed for eight months. The operation was performed February 1, 1927, at the Hospital for Ruptured and Crippled. There was an enormous amount of scar tissue and soft part deformity at the site of the fracture. The scar tissue was excised. The ends of the fragments were sawn off obliquely so that when the pectoralis major muscle contracted the upper fragment pulled against the oblique surface of the lower fragment. With a one-quarter inch drill a hole was made through the bones about three-quarters of an inch from the fractured ends. A long strand of fascia lata about three-eighths inch wide was removed from the left thigh, the same technic being used as in the preparation of a fascial suture for a hernia repair by the method of Gallie. This strip of fascia was passed through the drill holes, then crossed posterior to the approximated fragments, brought around anterior to the fragments and tied with a square knot. This knot was sutured with chromic catgut. Following the operation the patient developed a pneumonia and a phlebitis in the right thigh, multiple abscesses formed over various portions of his body and from time to time three of them were opened. On the eleventh day post-operative the operative wound which had been absolutely quiet, began to turn red and for the first time gave the patient pain. The wound was laid open. The fascial suture held for ten days in the presence of the infection, but was finally removed on the twenty-first day post-operative as a fascial slough. The wound finally healed and solid bony union was obtained. Patient is now using the arm as an instructor in carpentry.

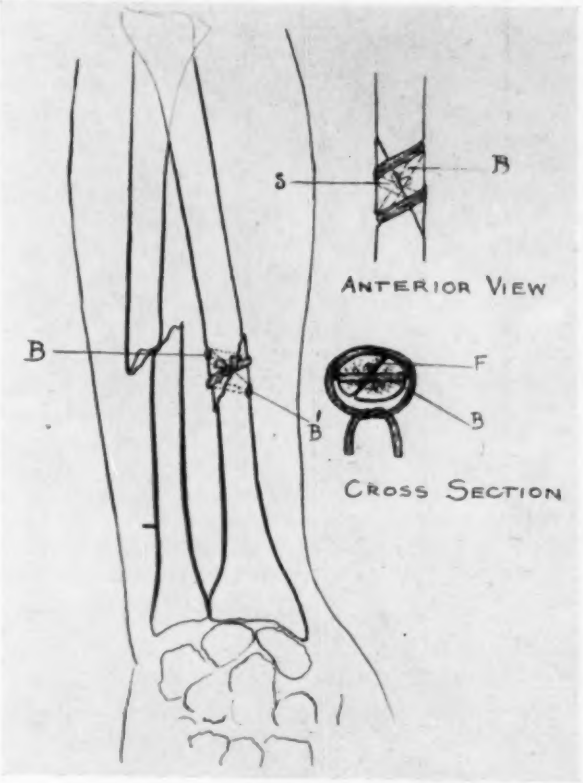

FIG. 3.—Fracture of both bones of the right forearm. Fracture approximated. Suture B—B′ passed through drill holes, crossed on one side of the bone, brought around and tied on the other side. Inserts show anterior of the sutured fracture and also a cross-section of same, S indicating the suture passed through drill hole B, F the fracture line.

CASE II.*—(Fig. 2.)—Patient O. P., age thirty-five. Re-admitted to Bellevue Hospital, April 23, 1927. The patient was in an accident, April 10, 1927, at which time he received two fractures of the left fibula, a chip fracture of the internal malleolus and an oblique fracture with a three-inch splintered fragment at the junction of the middle and lower thirds of the left tibia. There was so much swelling and ecchymosis that satisfactory reduction was not obtained. It was thought advisable to do an open operation. This was done April 30, 1927. A long curved incision was made over the flat surface of the left tibia. There was found an oblique fracture. The distal fragment

* This case was presented at the Surgical Section of the New York Academy of Medicine, May 4, 1928.

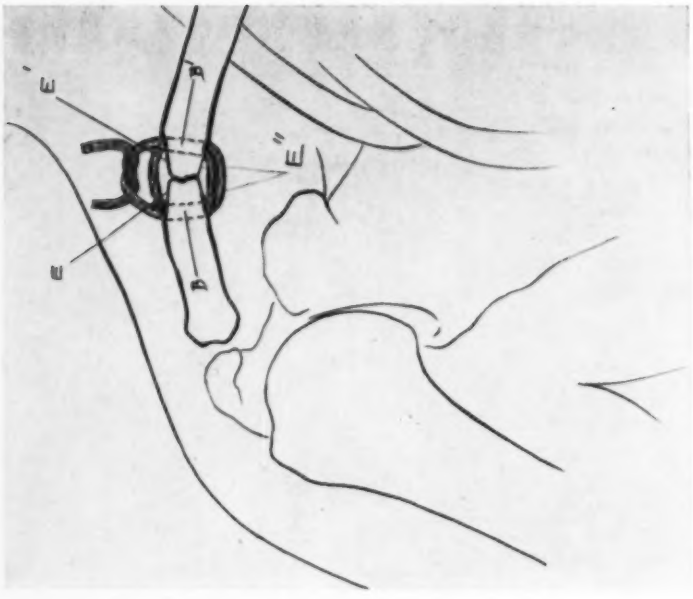

FIG. 5.—Fractured right clavicle. E—E' and E'' indicating portion of fractured ends shaved down so as to form a bed for the suture passed through drill holes B—B'. Fracture ends approximated.

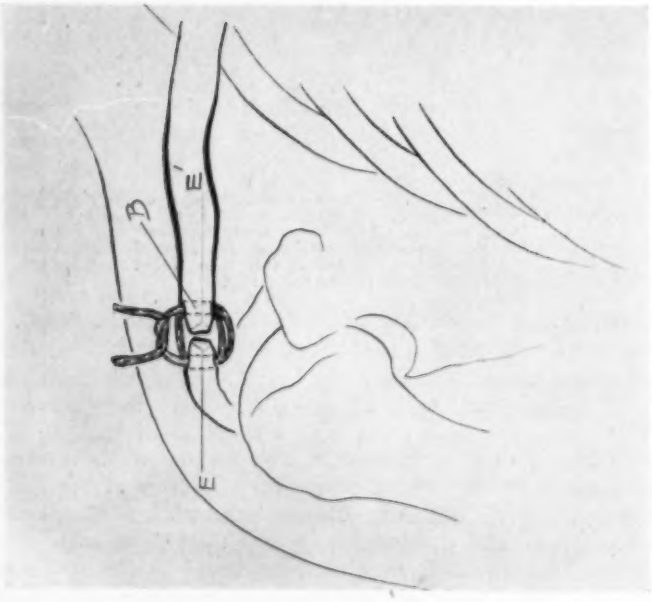

FIG. 4.—Dislocation of outer end of clavicle. E—E' ends of bone shaved down so as to prevent fascial suture forming a lump on the shoulder. B drill holes through ends of bones. Dislocation reduced. Fascial suture passed through drill holes B.

was displaced laterally. There was a third fragment three inches long very lightly held by callus and very easy to deliver from the wound. The fragments were separated with a chisel and put in proper alignment. The third fragment was laid along the lateral side of the fracture, from whence it had been displaced, so that it bridged across like a bone graft. Two long strips of fascia lata three-eighths inch wide were removed from the right thigh and were tied around the ends of the third fragment on either side of the main fracture line. Chromic catgut sutures were used to secure the fascial knots. The periosteum was closed with plain catgut, the skin with silk, and a long circular plaster bandage was applied from above the knee including the foot. The wound healed by primary union. Post-operative X-rays showed excellent alignment of the fragments. Patient was discharged from the hospital with a light plaster bandage on the thirty-third day post-operative. Bony union was rapid. Patient was back at his work fourteen weeks after operation.

Case III.—(Fig. 3.)—H. F., female, age fifty-eight. Admitted to Bellevue Hospital, February 24, 1927. Four weeks prior to admission patient had fallen with the right forearm extended, receiving a fracture of both bones of the right forearm. Satisfactory treatment had not been possible because patient had been in a psychopathic ward. Examination showed her to have a fracture of both bones of the right forearm, middle third. There was ulnar and palmar displacement of the distal fragments. There was three-quarters inch shortening and no union was present. Operation performed February 28, 1927. Incision four inches long was made over the lateral aspect of the right forearm. The fractured ends of the radius were exposed, freshened and approximated. A one-quarter inch drill hole was made obliquely through the ends of the fractured bone. A strip of fascia lata one-quarter inch wide was taken from the left thigh and passed through the drill holes, crossed on one side of the fractured ends, brought around and tied on the other side, and the knot secured with chromic catgut. The ulna was not disturbed. The wound was closed in layers in the usual manner. The arm was put in a plaster-of-Paris bandage with the elbow in flexion and the hand supinated. The wound healed by primary union. April 23, 1927, there was solid bony union present in the radius. Passive motion of all joints was fair. On this date physical therapy was recommended and all splints discontinued.

Case IV.—(Fig. 4.)—J. K., age forty-three. Admitted to Bellevue Hospital, May 13, 1927. He had been injured in a taxicab accident. Examination showed him to have a dislocation of the left clavicle with a separation of the acromio-clavicular joint of about two inches. Patient was operated, May 16, 1927, under gas and oxygen anæsthesia. Transverse curved incision was made over the acromio-clavicular joint. The ends of the acromial process and the clavicle were exposed and a one-quarter inch drill hole put through each end. The ends were shaved down with a sharp chisel so that when the suture was tied too much of a lump would not be formed on the shoulder. A long strip of fascia lata was excised from the right thigh. The fascial suture was run through these drill holes and one end carried through the second time and a knot tied on top. The knot was secured with fine chromic catgut. The wound was closed in layers and with ordinary muslin bandage and adhesive the right arm was flexed at the elbow and put up in a modified Velpeau bandage. Primary union was obtained. All bandages were removed in three weeks. A stable, useful shoulder, with normal function, was obtained and X-rays of the joint showed normal anatomical relationship.

Case V.—(Fig. 5.)—F. M., age forty-eight. Admitted to the Hospital for Ruptured and Crippled July 7, 1927, having received an injury to his left shoulder July 1, 1927. Examination showed him to have a fracture of the left clavicle at the junction of the outer and middle thirds. The proximal end of the distal fragment was displaced downward and backward. Better position was sought with the patient under anæsthesia and the application of a plaster spica to his shoulder. This procedure did not improve the position. Accordingly on March 12, which was eleven days after the injury, an open reduction was done. A curved transverse incision with the convexity of the curve out-

ward, was made over the acromial end of the left clavicle. The fracture ends were delivered and prepared as in Case IV. One-quarter inch drill holes were bored through the clavicle on either side of the fracture. A piece of fascia lata several inches long was run through the second time and the fascia tied securely, the knot being fixed with chromic catgut. The fascial strip used was a leftover from a hernia operation of some ten days previous. The fascia had been kept in Scott's solution. The wound was closed in layers and with muslin bandage and adhesive a shoulder spica was put on the patient. The wound healed with a slight drainage of serum for several weeks. Perfect anatomical position and solid bony union were obtained as well as good function in the shoulder.

CONCLUSIONS

1. The fascial suture is recommended as a method of internal fixation in certain bone and joint injuries.

2. Fourteen consecutive cases have given excellent results. Five of the cases are reported in detail.

3. The suture held for two or more weeks in one case which became infected.

4. Case II would suggest that the fascial suture might be of great use in holding a bone graft in place.

5. Dead sutures or "leftovers" from hernia operations may be used, and in one case did the same work as if autogenous.

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AINHUM

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Ainhum or "Dactyolysis Spontanæ" is of African derivation meaning "to saw or to cut", and is given to a curious disease affecting colored races—more particularly the black. It is characterized by a slow amputation of one or more digits—generally a symmetric separation of the little toes, although other toes or even fingers may be affected.[1]

The disease was first reported by G. Messum in 1821.[2] It was first described by J. F. Da Silva Lima of Bahia in 1852, and fifty cases reported thoroughly described by Da Silva Lima and Wuncherer in 1867.[3, 4] Clark, in 1860 noticed this condition among the natives of the Gold Coast and described it under the heading of "Dry Gangrene of the Little Toe".[5]

Up to 1905, only twenty cases of this condition had been reported in the United States.[6] It has been reported in North Carolina by Harnaday and Pitman in 1881, and in Western Virginia in 1884 by Dubring.

The etiology of Ainhum is unknown and very little progress has been made toward arriving at any definite conclusion as to its causative factors. Theories of self-mutilation, wearing rings or tight bands, or bearing a relationship to leprosy may be dismissed as they have very little to substantiate them.

Wuncherer describes this as a form of tropho-neurosis. The question of heredity has been discussed by some writers. Da Silva Lima in his series of cases describes an entire negro family all the members of which presented this condition. Manson's own impression, supported by several others is: "That it is provoked, at all events in the first instance, by wounds so easily inflicted on bare feet in walking through grass and jungle, and which through constant irritation, produced and kept up by wounds from sharp grasses and so forth, would in time give rise, especially in the dark skinned races so prone to keloid, to fibrotic changes of the derma, which might very well end in a sort of cicatricial contraction, and ultimately in a slow atrophying strangulation of the affected member." [7]

Castellani and Chalmers believe the condition to be one of parasitic origin —infection taking place probably through small superficial lesions or wounds which may be found in people who go around barefooted.[8]

Pathology.—Dr. F. B. Mallory, of Boston, gives the following description of the pathological histology of this disease: "Sections show marked sclerosis of the arteries, with partial to complete obliteration of them, a little chronic inflammatory reaction and marked infiltration with mast-cells. Tubercle bacillus and Gram-Weigert stains for leprosy bacillus negative." [9]

Doctor Jimenez, röntgenologist, made the following report: "The most striking feature of the radiographs is the almost total disappearance of the middle phalanx of the little toe, of which there is only a very small fragment left, and of the proximal phalanx

only the proximal end is left at the metatarsophalangeal joint. (The soft parts show a constriction amounting to almost complete detachment of the little toe at the digitoplantar fold. The phalanges of the other toes, in the diseased foot as well as those of the sound foot, show atrophic changes." [10]

According to Unna there is a primary degeneration of the skin, a sort of ring-formed scleroderma with callous formation of the epidermis, which by its seat at the base of the limb leads to a secondary total necrosis. There is an endarteritis by which the blood supply is gradually shut off to the distal part of the toe. The toe becomes œdematous and fatty while the bone undergoes a rarefying osteitis, so that the digit is gradually separated from the foot." [11] Wuncherer,[12] Schuppel,[13] Dhuring,[14] Eyles, and more recently Darling have made extensive examination of the specimens of toes taken from patients suffering from ainhum.

FIG. 1.—Plantar surface of both feet with small toe of right foot missing.

A most interesting résumé is given by Dr. Henry Weinstein.[15] "The epidermis is increased, the stratum lucidum slender, the papillary layer elongated, and in the rete Malpighii the pigment is found irregularly distributed. The constricting ring is made of dense fibrous connective tissue covered by a layer of epidermis. The process travels from the base at the constricting band, gradually to the top, involving all the structures in proper turn, and while the proximal parts show atrophy, the distal parts show degenerative changes.

In the part distal to the constricting ring the pigmentary layer shows many germinal cells, while in the neighborhood of the ring the deeper layers of the skin show atrophy. The corium papillæ are elongated, the surrounding capillaries dilated, and the perivascular lymph spaces are filled with corpuscular elements, especially young connective tissue cells.

The subcutaneous tissue is increased at the expense of muscle, tendon and soft parts, while here and there may be seen islands of fat cells. The sweat glands are very much atrophied and in the space between the glands there is much cellular infiltration, consisting of young connective tissue cells, fat and lymph cells. The original cells show cloudy swelling, together with granular and hyaline degeneration.

The blood-vessels are everywhere numerous; the larger arteries are engorged, all the coats thickened by the connective tissue replacement, including the proliferation of the subendothelial connective tissue, leading ultimately to endarteritis obliterans. The smaller arteries show very much thickening of the adventitia and much perivascular infiltration. The veins are dilated, thickened but empty. The lymphatics are also dilated and the lymph spaces in a state of engorgement.

In the bone there is a condition of rarefying osteitis, advancing from the periosteal side. The destruction in the interior is rapid, the cavities filled with reticulum of connective tissue, blood-vessels, numerous round cells and fat globules, the bone corpuscles being few in number. The ultimate result is the change of all the parts into dense fibrous tissue.

To summarize the pathological findings: We meet first a condition of inflammatory œdema. Later on there is found degeneration of original elements, followed by atrophy. The highly organized tissue, such as sweat glands, blood-vessels, muscles and bone are all changed into connective tissue. In all there are evidences of impaired nutrition due to pressure, vasomotor and trophic manifestations."

Symptoms.—The disease is now considered purely a local disturbance. Clinically the disease is characterized by the formation of a fissure which forms at the root of the toe, usually on the plantar surface.

FIG. 2.—Ring-like constriction about small toe on left foot.

The male negro subject and the fifth toe are most usually attacked. Age is important as it is a disease of adolescence. Cases reported in America have always had a history of African parentage.

The fissure may appear on one toe, the other remaining sound or may appear simultaneously in both toes. It tends to be symmetric. The fissure deepens and spreads laterally and dorsally until the two wings connect which usually occurs on the dorsum of the foot.

The toe eventually becomes completely encircled causing a strangulation. The strangulation that ensues seems to depend upon the hyperplasia and growth of the epithelium plus the formation of a ring of fibrous tissue. The skin is thick, dry and tough.

If allowed to run its own course, this process may last from two to ten

years. There are cases on record which have lasted from fifteen to twenty years.

This strangulation is without pain at the beginning, but as the disease progresses may become very painful. There is very little ulceration and practically no bleeding. Beyond the ring of constriction the toe becomes enlarged and bulbous—presenting the appearance of a small cherry attached to the foot by a small pedicle. Eventually the distal portion usually becomes

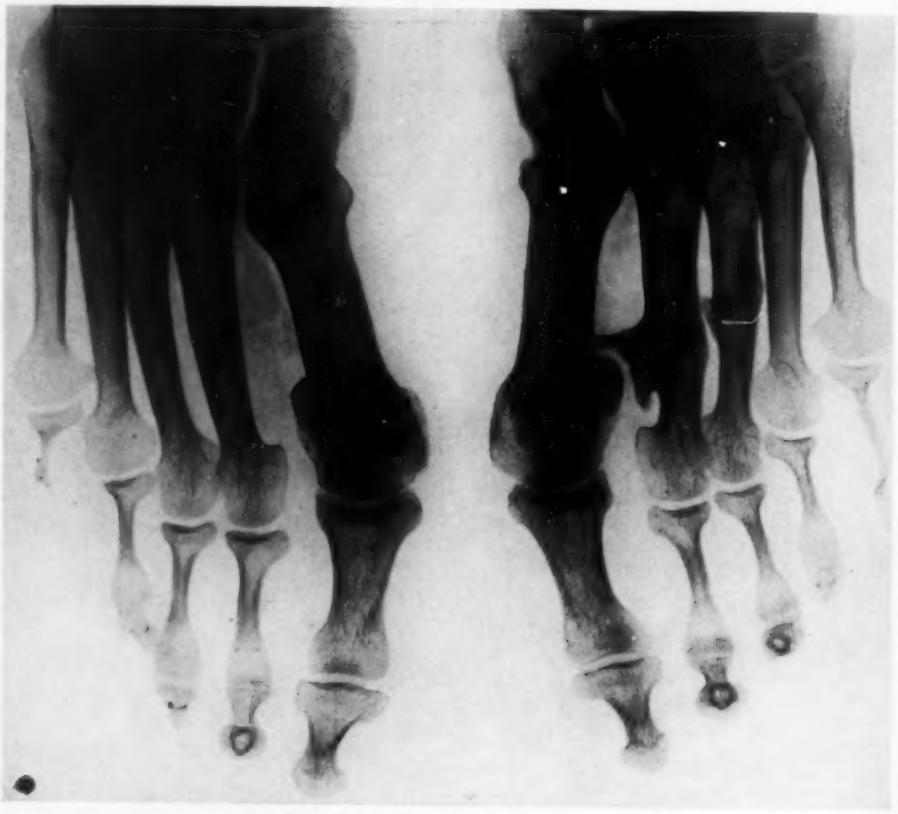

FIG. 3.—X-ray findings at time of admittance.

amputated spontaneously leaving a small ulcer which heals without trouble. There are no constitutional symptoms.

Treatment.—There is no known treatment that will preserve the toe after the strangulation has progressed to any appreciable degree. Facio recommends amputation as soon as diagnosis is made.

CASE REPORT.—The case to be reported here is the only one ever admitted to the Washington University Clinic, and as far as known, the first one ever reported in the State of Missouri. The patient had been in this country all his life, his birthplace being Mississippi.

B. B., a negro, age forty-five, first seen October 13, 1922, complaining of bad toes. Family history essentially negative. Past history: Noticed little toe on left foot began to get sore about a year ago. It has become well and then sore again since that time. On October 6, 1922, which is three days ago, dropped lump of coal on his left foot and since

then the toe has become very painful and almost constant in annoyance. He states that about one year ago he noticed a beginning constriction forming or tending to encircle the base of this left small toe. This constriction has been gradually progressing—becoming deeper and tending for the two ends to meet. He has been applying some medicine as prescribed by a physician.

The small toe of the right foot is missing—having been mashed off (he states) while working. (No history of injury—but states that for a year prior noticed a constricting band of the same character that is now present on the left toe.)

Physical Examination.—Good pulsation in both anterior and posterior tibial arteries on left. Corns on toes at second and third phalangeal joints. Legs in good condition. Little toe of right foot has been amputated. Left foot first four toes bend under—little toe is greatly swollen. On under surface there is a constricting band more marked on under surface extending around entire toe.

Heart and lungs negative. Abdomen negative. Blood—hæmoglobin 86, red blood cells 4,200,000, white blood corpuscles 10,800, polymorphonuclears 60 per cent., small mononuclears 26 per cent., large mononuclears 6 per cent. Count—100 cells. Urine—negative for albumin and sugar. Wassermann—negative.

X-ray Findings.—(Dr. Sherwood Moore.) Anterio-posterior view of both feet. The ungual phalanx of the fifth toe on the right foot is lacking and the proximal one is the seat of great atrophy. The ungual phalanx on the opposite side is very narrow and thin and the proximal is extremely narrow. The proximal phalanges on the three outer toes of each foot have been very narrow shafts and very narrow medullary cavities. The second and third metatarsals on the left foot show deformity, suggesting an old fracture. The third with a rather sharp spur on its inner aspect. The second has a large sessile exostosis with two sharp projections, one forward and one internally, the whole giving an appearance as if it had articulated with the external sesamoid bone of the great toe. X-ray diagnosis: Localized bone atrophy of phalanges, old fracture of metatarsals—"Ainhum."

Treatment.—Amputation at metatarsal phalangeal joint under ½ novocain in usual method—skin sutured with silk (October 13, 1922). October 30, 1922, healed first intention.

Epicritical Remark.—This case is of particular interest because the patient is a native of this country and has never left the United States. An unsuccessful attempt has been made to get into communication with him since his discharge.

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A STUDY OF 520 CASES OF FRACTURES OF THE SKULL*

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With the steady increase in the number of accidents due to automobile and industrial injuries the study of a related group of cases becomes of interest, and as there has been no discussion of fractured skulls and intracranial injuries in this Society for several years, we are presenting as a basis for discussion an analysis of 520 cases treated on the First Surgical Division of Bellevue Hospital during the past eight years. The recent literature has been collected by McClure and Crawford [1] in their report of cases of head injury from the Harper Hospital. In addition, Vance [2] has recently published a most thorough study of 512 necropsies, and Beekman [3] has reported 330 cases from the Childrens Surgical Service of Bellevue. Four hundred and thirty-five of our cases were men, eighty-five women, figures which correspond closely with Vance's of 445 and sixty-two, respectively. The sex incidence is of little interest from a purely medical standpoint, for men in their occupations, habits, and customs are much more exposed and prone to bodily harm than are women. Furthermore, no attention has been paid to incidence by decades, for here again this means nothing, *per se*. Due consideration would of necessity have to be given to the tables of life expectancy in the various decades and also to the varying degrees of activity and exposure between a man of twenty to thirty and one of sixty to seventy. All of the cases reported here were in adults.

The causative agents were as follows:

Table I.

Causative Agents.

	Our cases	Vance
Automobile	110	189
Falls	179	156
Blows	62	33
Bullet	3	
Unknown	140	100
Street car	14	19
Train	3	
Crush	5	
Horse and wagon	4	

* Read before the New York Surgical Society, April 11, 1928.

The importance of alcohol as a factor has been difficult to determine. The patient in stupor or irritable as the result of an intracranial injury, given a drink by a sympathetic friend, may easily be noted as alcoholic by a house officer. Vance's finding of alcohol in the organs of 28 per cent. of cases dying inside of ten hours is more accurate than any clinical observation.

TABLE II.

Classification.

Clinical grouping		111 autopsies	Vance
Base	347	44	
Vault	90	15	36
Vault and base	57	52	471
No fracture	4		
Undetermined	22		
Compound	37		
Depressed	27		

A grouping of this sort is necessarily inaccurate but probably shows the most important portion of the fracture fairly well. In comparison with the autopsy figures it would indicate the higher mortality of the basal fractures.

In seventy-seven cases there were complicating injuries, seventeen of which were sufficiently severe to insure a fatal issue. The clavicle was the bone most often fractured—seventeen cases—while there were nine fractures of the femur, nine of both bones of the leg, and four each of the radius, ulna, and humerus.

On admission 178 cases were conscious and rational, 123 stuporous, 219 in coma. In almost all the conscious cases a history of unconsciousness of varying duration was obtained, very few patients in this series escaping without at least a slight concussion. One hundred and thirty-two were noted as being in shock, but as only thirty-five had blood pressures below 100, while forty-nine were specifically treated for shock, it is probable that most of these were victims of severe concussion rather than of true shock.

TABLE III.

Blood Pressure on Admission.

Below 100		35
Recovered	16	
Died	19	
100–150		313
Recovered	209	
Died	104	
Over 150		66
Recovered	31	
Died	35	
Not taken		106

The blood pressure readings were repeated at frequent intervals but changes were of less value in determining intracranial pressure than we had anticipated.

In individual cases the variation from one reading to another a few hours

later was very considerable, while often the readings did not check with the information derived from spinal tap, operation or autopsy.

Pulse.—The pulse on admission was below 60 in thirty-one instances. Twenty-one of these patients died, six after operation. The rapid development of increased intracranial pressure in these cases usually indicated lesions too extensive for control by operation or other means.

TABLE IV.

External Signs of Fracture.

Scalp wounds	216
Wounds communicating with fracture	37
Hæmatomata	147
Depression	27
Bleeding from ears	142
Bleeding from nose	104
Bleeding from pharynx	36

Scalp wounds and hæmatomata were of considerable importance in determining probable sites of skull and brain injury as well as of the location of contre-coup injuries. Wounds, however, led directly to fractures in surprisingly few instances.

Bleeding from nose or pharynx are of doubtful significance owing to the possibility of extracranial injury. In these cases local injury was so far as possible ruled out and there were other evidences of fractured skull. In a few cases the discharge from the nose was cerebrospinal fluid.

Bleeding from the ear through a ruptured drum is of much more significance. Once in a while it may occur as a result of drum rupture without fracture. Occasionally the line of fracture will pass into the external canal without involving the drum. We believe that patients bleeding either from the drum or from a laceration deep within the external meatus should be treated as fractured skulls, with the possibility of the development of meningitis always in mind.

TABLE V.

Eye Signs.

Pupils		
Equal, normal reactions		284
Recovered	231	
Died	53	
Fixed		164
Recovered	36	
Died	128	
Dilated		
Recovered	21	
Died	76	
Contracted		
Recovered	10	
Died	16	
Unequal		
Recovered	5	
Died	36	
Not recorded		72
Fundi		
Œdema or hæmorrhage		62
Normal		92
Not examined		366

The fixed pupil was a serious sign. When unequal, the larger pupil indicated the side of the lesion with considerable exactitude. The conditions of the pupils often changed rapidly and in this way they were of considerable value in determining the patient's progress.

Examination of the fundi would probably show a larger percentage of changes if carried out as a routine and at frequent intervals. Anatomically, it is the simplest and most direct way of determining intracranial pressures, aside from the spinal tap. In the hands of the average general surgeon or interne, however, with an uncontrollable patient and without artificial dilatation of the pupils, the findings may be questioned. Nevertheless, we believe it to be a very important diagnostic sign, too often omitted, and also too often neglected during the period the patient is under observation. We cannot urge too strongly repeated funduscopic examination as a routine part of the treatment of all cases of intracranial injury.

TABLE VI.

Neurological Changes.

Cranial nerve paralysis		58
Recovered	44	
Died	14	
Spinal nerve paralysis		88
Flaccid paralysis	51	
Recovered	3	
Died	48	
Weakness	37	
Recovered	14	
Died	23	
Reflexes		
Superficial—Decreased		58
Deep		
Decreased		63
Increased		79
Abnormal		62
Convulsions		23
Recovered	9	
Died	14	
Negative neurological examination		127
Subjective changes		51
Vertigo		
Headache		
Irritability		
Drowsiness		
Vomiting		56

The cranial nerves most often involved were the seventh and eighth, less often the third and sixth, and least often the first. Discovery of injury to the latter was usually late, the patient often complaining of loss of taste and smell only on return to the follow-up—a commentary on the sameness of taste of hospital food.

Generalized paralysis or convulsions were an indication of severe concussion, associated with more or less brain laceration in all cases, and were of very grave prognostic significance. In these cases the coma was usually deep, the pupils fixed, blood pressure low, and death a matter of a few hours.

Localized weakness or spasticity—always sought for as indication for operative intervention—and accompanied by changes in reflexes, was of great

value in determining the site of injury. It was often impossible to tell whether the condition was due to extradural bleeding or to brain laceration as in this series the typical syndrome of epidural hæmorrhage was conspicuous chiefly by its absence.

The subjective changes noted were unquestionably too few, as practically all patients complain of headache, and at some time or other, if not in coma, present the irritability characteristic of meningeal irritation.

Vomiting has been of little importance. Projectile in only ten or twelve cases we have thought of it as due more often to alcohol than to trauma.

TABLE VII.
X-ray Findings.

Total examined	228
Negative (61%)	140
Fracture of vault	75
Fracture of base	13

All of the cases reported as negative were confirmed by other means. The high percentage of negative reports is interesting in comparison with Beekman's figures from the Childrens Service, fifty-seven of one hundred and twenty-three cases with positive X-ray reports "having none of the classical symptoms of fracture," while in only 21 per cent. of the cases X-rayed was there a negative report.

The technic—particularly in fractures of the base—is difficult, and demands a considerable number of exposures, while the interpretation of grooves that may be normal is at times a matter of difficulty.

When positive, the plates are of great value, but we have come to disregard a negative report.

TABLE VIII.
Spinal Fluid.

Total cases tapped	414
Bloody fluid	398
Pus	3
Clear	13
Pressure	
Increased	209
Normal	185
Decreased	12
Not noted	8

There has been discussion of the advisability or safety of spinal tap in these cases, and emphasis has been laid on the danger of causing medullary pressure. We believe that this danger has been over-emphasized and that the advantages to be gained—both diagnostically and therapeutically—outweigh the risks. In this series the only complication has been the breaking off of a needle in one case, fortunately not in the canal.

The diagnosis in the cases with clear taps have been established by X-ray, operation or by the presence of cranial nerve paralysis.

While the presence of blood in the spinal fluid strictly speaking means only sub-arachnoid hæmorrhage—either from brain laceration or pial hæmorrhage —it is rarely found in traumatic cases without a fracture, and, as it is in itself

an indication of brain injury, should be considered an indication for treatment as a fracture—particularly if we realize that in treating a fracture of the skull we are using that terminology for convenience and from habit, and are in reality concerned with the treatment and course of the underlying brain injury.

The amount of blood varied from a minimum only to be noted on standing to—in three cases—a fluid sufficiently bloody to clot in the tube. The fluid is drawn into three test tubes, and the test considered negative unless the third tube is at least as bloody as the first.

It is of interest, perhaps, to mention here a few of the patients in whom the injury was relatively slight and the symptoms evanescent. The common causative factor in this group was either a fall or a blow, following which the patient was stunned or knocked out for only a few moments and then complained only of headache of varying degree. On admission their physical and neurological examinations were entirely negative and their subjective symptoms rapidly subsided. Were it not for the information gained by spinal tapping they would have been classified merely as mild concussion. Here lumbar puncture with fluid uniformly bloody in all three tubes gave a more correct diagnosis.

At first, the pressure was noted crudely, by the rate of flow, more recently by the manometer. In 209 cases it was increased usually to from 20 to 30 mm., in one case to 50 mm. Unfortunately no accurate readings were taken in the cases in which it was noted as decreased.

While the amount of blood in the spinal fluid gave us little information as to the future course, the determination and correction of increased pressure was of great importance.

The routine treatment of this group comprised:

Treatment.—1. Treatment of shock. 2. Physical examination with especial reference to eyes and neurological signs. 3. Cleansing and exploration of scalp wounds. 4. Blood pressure readings. 5. Spinal tap. 6. Ophthalmoscopic examinations of the fundi. 7. Treatment of increased intracranial pressure.

This, in the majority of cases, was controlled by one early spinal tap, with reduction of pressure to normal. When this was inadequate magnesium sulphate by mouth or rectum was used in the milder cases. We have used hypertonic solutions intravenously in a few cases, too few to have a considered opinion of their value, but with less satisfaction in the use of saline than glucose. In the more severe cases repeated spinal taps have been the most valuable method of treatment.

Twenty-three cases have required two taps, four a third and four a fourth. We have not hesitated to remove slowly enough fluid to lower spinal pressure to 10 mm. In no case has this required the removal of more than 50 c.c. of fluid.

Certain supportive and symptomatic treatment has also to be considered. For the unconscious patient an adequate supply of fluids must be maintained. This we have found to be most expeditiously accomplished by hypodermoclyses of normal saline or 5 per cent. glucose solution. Very frequently

sedatives are demanded. Here paraldehyde, sodium bromide, chloral hydrate, and luminal are the drugs most commonly used. Particularly at first, with an alcoholic or delirious patient paraldehyde by rectum is especially valuable, and alternating with this chloral and the bromides may be administered in a similar manner. Luminal has proved itself most useful and beneficial in our hands. During the patient's stay in the hospital he is given a small dose three times a day and is instructed to continue it for two to four weeks or longer after his return home. With its use we have felt that the irritability, headache, and dizziness have been less noticeable. Other sedatives or hypnotics are used as indicated. We do not use morphine primarily because of its depressant action on the respiratory centre, its diminution of the cough reflex, and because of its occasional unfavorable action with certain patients. We do not hesitate, however, to employ it when indicated or if other sedatives fail.

On discharge the patient is instructed to lead a very careful and well regulated life for a month or six weeks with long periods of absolute rest during each day.

8. Rest in bed for three weeks.

This is a difficult regulation to enforce, many patients seeing no reason for staying on after their immediate symptoms have cleared up. Sixty-three left at their own risk after a shorter stay.

9. Operation.

TABLE IX.

Operations.

Total number		62
Pathology		
Compound	5	
Depressed	11	
Epidural hæmorrhage	21	
Subdural hæmorrhage	19	
Bullet wounds	2	
Mastoiditis	3	
Brain abscess following compound fracture	1	
Operation within 24 hours of admission		45
Recovered	20	
Died	25	
Operation after 24 hours		17
Recovered	11	
Died	6	

TABLE X.

Operative Mortality.

	Early operations		Late operations	
	Recovered	Died	Recovered	Died
Compound fracture	3	2	.....	.....
Depressed fracture	7	2	2	0
Epidural hæmorrhage	7	11	2	1
Subdural hæmorrhage	1	10	4	4
Bullet wounds	2	0	.....	.....
Mastoiditis	.....	.....	2	1
Brain abscess	.....	.....	1	0

Sixty-two patients (12 per cent.) have been operated on, with thirty-three deaths (53 per cent.).

Operation in the early stages, while the patient is still in shock or concussion, even in the presence of localizing signs, is probably unwise. It was done at times, usually with the discovery of a collapsed non-pulsating brain which did not expand with the removal of the clot and which in several cases had not expanded at autopsy.

It would seem that concussion in these cases was the cause of death, rather than pressure. When the patient recovered from concussion operation might be expected to have more favorable results.

The longitudinal sinus was torn in three cases, and successfully repaired by an aponeurotic graft in one.

TABLE XI.

Mortality.

Total (39%)	204
Within 6 hours	76
6 to 12 hours	34
12 to 24 hours	22
24 to 48 hours	16
Over 48 hours	56

In the cases dying within twenty-four hours the picture was that of severe concussion, usually with no signs of local pressure. The patients were unconscious, the pupils fixed and usually dilated, occasionally unequal. Reflexes were abolished and there would be a generalized paralysis. Respiration was usually deep and stertorous, gradually becoming Cheyne-Stokes in type, while the pulse, never full and bounding, gradually became more feeble and rapid. Autopsy on these cases usually showed extensive brain laceration and not infrequently localized epidural or subdural hæmorrhage of which there had been no localizing signs.

In the later deaths, pneumonia was a factor in twenty-two, exhaustion in eight.

Meningitis occurred seventeen times, more or less evenly distributed among fractures of the anterior and middle fossa and compound fractures of the vault. Streptococci were found in two, staphylococci in two, pneumococci and B. coli each in one, an unidentified Gram-negative intracellular diplococcus in three, while in seven the organism was not found. One case recovered. In this a Gram-positive intracellular diplococcus was found repeatedly in a sero-purulent spinal fluid which gradually, without specific therapy, cleared up.

Thanks to the coöperation of the medical examiners we have records of autopsies in 111 cases.

TABLE XII.

Autopsies.

Fractures of vault	15	
Fractures of base	44	
Fracture from vault to base	52	
In cases dying within 48 hours		76
In cases dying over 48 hours		35

TABLE XII—*Continued*

Findings	Early cases		Late cases	
Brain laceration	57		13	
Laceration into ventricle	2		6	
Epidural hæmorrhage	21	2 operated 19 not operated	6	2 operated 4 not operated
Subdural hæmorrhage	45	3 operated 42 not operated	11	2 operated 9 not operated
Torn sinus	4		1	
Meningitis	0		8	
Pneumonia	2		10	
Exhaustion	0		2	

The large number of epidural and subdural hæmorrhages is the striking feature of this chart, and led us to a review of these cases, with the feeling that cases had been missed that might have been benefited by operation. Of those with epidural hæmorrhage eight were found to be small and merely incidental to extensive subdural hæmorrhage and brain laceration.

TABLE XIII.

Unrecognized Epidural Hæmorrhage.

Epidural clot	Subdural clot	Brain laceration	Pupils	Neurology	Blood pressure	Pulse	Death
90 gm.	Small		Equal, react	Flaccid paralysis			6 hrs.
240 gm.			Unequal, fixed	Hæmiplegia	104/40	70	3 hrs.
130 gm.		+	Unequal, fixed	Bilateral spasticity	150/100		6 hrs.
Large (right)	Large (left)	Deep	Equal, react	Coma 7 days			12 days
48 gm.		Deep	Unequal, react	Flaccid paralysis	125/75	124	4 hrs.
50 gm.		+	Equal, react	Generalized weakness; reflexes normal	100/80		24 hrs.
100 gm. (Posterior)			Equal, react	Spastic arm reflexes normal	120/75	86	22 hrs.
100 gm. (Right, Posterior)		+	Unequal, fixed	Left hæmiplegia	120/60	60	8 hrs.
175 gm.		Hæmorrhage in basal ganglia	Dilated, fixed	Flaccid paralysis; right and left Babinski			8 hrs.
+	80 gm.		Dilated	Left hæmiplegia	110/60		8 hrs.
145 gm.	+		Dilated, fixed	Right; reflex left	120/50	50	12 hrs.
70 gm.	+	Extensive	Fixed, unequal	Reflexes; hyperæsthesia; right and left Babinski		136	8 hrs.
63 gm.			Fixed	General spasticity	200/80	96	¼ hr.
52 gm.	32 gm.	+ Hæmorrhage in lateral ventricle	Negative	No paralysis; right reflexes left	175/90		5 hrs.

These cases might have been aided by operation, but in most of them concussion apparently prevented the development of localizing signs.

It is interesting to note of how little value the blood pressure and pulse rate was in the determination of intracranial pressure.

In one other case there was a distinct hospital error—a patient treated for alcoholism and scalp wounds, sent home, and readmitted twelve hours later, moribund, post-mortem no intracranial injury other than a large epidural clot. This was one of the few cases in which the typical history of epidural hæmorrhage could be obtained.

Of the fifty-one unoperated cases showing subdural hæmorrhage at autopsy only five were noted as showing signs of brain compression. The largest clot measured weighed 250 gm., but two of 60 and 70 gm. caused definite pressure. One case showed localizing signs but died shortly after admission. In three repeated taps were done. All these died within twelve hours.

Of the 316 patients discharged, sixty-three left at their own risk while twenty-eight were discharged to other hospitals. No attempt was made to follow either of these groups. Fifty-seven disappeared and could not be traced. We have, however, been able to trace 168—146 non-operative and twenty-two operated cases.

TABLE XIV.

Follow-Up of Non-Operative Cases.

	Followed to				
	6 months	6–12 months	12–18 months	18–24 months	2 years +
No complaints	23	22	9	10	8
Dizziness	12	9	6	2	2
Headache	9	5	2	2	3
Tinnitus	4	1	1	0	0
Deafness	6	4	3	3	2
Other cranial nerve weakness	1 (VII)		2 (I)	1 (I)	1 (VII)
Extremity weakness	1				
Mental changes:					
Irritable	2	1			
Nervous	3		3		
Melancholic				1	
Insane			1		
Epilepsy improved		1	1		
Died			1		

TABLE XV.

Follow-Up in Operative Cases.

	Followed to				
	6 months	6–12 months	12–18 months	18–24 months	2 years +
No complaints	4	4	1	3	1
Dizziness	2				1
Headache		2	1		
Motor aphasia	1				
Amnesia		1			
Blind in one eye					1
Nervous and irresponsible					1
Died	*1				

* Meningitis following revision of mastoid.

Eighth nerve symptoms, dizziness, tinnitus and deafness were by far the most common sequelæ. The former were always most marked, or else only noticed, on sudden changes of position. To most of the patients it seemed to be an annoyance rather than a definite detriment to their well being. Tinnitus when present was complained of much more bitterly.

There is a definite tendency for symptoms to improve over a period of from eighteen months to two years but symptoms persisting after that time seem to be permanent. If the air injection suggested recently by Penfield [4] is of value it will be in the treatment of this small group of patients with persistent headache.

The follow-up of the operated group is too small to be of value. About half of the recovered cases when last seen were free from symptoms, probably a smaller percentage of good results than in the other group, as might be expected, most of these cases having had more severe injuries.

SUMMARY

We have presented the review of these cases of Fractured Skull from one division of Bellevue Hospital. In studying it we have been impressed—and discouraged—by the high mortality of the early hours, a mortality due in most part to cerebral concussion and not to be controlled by the means now at our disposal. In the later hours more frequent use of lumbar punctures may be of value.

Operation in the first twelve hours, with the patient still in concussion is of little value, aside from the toilet of compound fractures. The depressed fracture is not of itself an urgent indication, while the epidural hæmorrhage, with its classical picture of unconsciousness, recovery, and gradually developing coma has in our series been a rarity.

Early and repeated lumbar punctures seem to be our greatest aid—and emphasize that in talking of fracture of the skull we are really concerned with the intracranial injury that lies hidden beneath the bone.

From our follow-up results it seems fair to draw the conclusion that 50 per cent. of these patients will eventually make a complete recovery although final abatement of symptoms may not occur until eighteen months to two years after the initial injury. Concerning the persisting symptoms and complaints there is no doubt that compensation and legal complications play a definite rôle. When one of these factors enters it is almost impossible to separate the wheat from the chaff. Of the permanent sequelæ, vertigo is common but rarely more than an annoyance; headache is common and sometimes quite disabling. Deafness, tinnitus, and disturbances of smell and taste are not uncommon, while there is a small group in which the final outcome, though not fatal, is distinctly unfortunate.

This entire series of cases has been treated with considerable conservatism and operation has been performed only when it has seemed to us to be specifically indicated. This is in line with the experience and ideas of others in recent years. One should not lean too far backward, however, but should be

constantly on the alert. Intervention should not be delayed where the intracranial pressure remains persistently high in spite of repeated attempts at relief or in the presence of suggestive local signs after the patient has weathered the initial shock and concussion, for it is in these cases that the possibility of a masked epidural hæmorrhage must be borne in mind.

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FRACTURE OF THE NECK OF THE FEMUR IN CHILDHOOD*

A REPORT OF SIX CASES

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Owing to its mechanical conformation the hip-joint must be susceptible to frequent injury at any age, yet the literature contains comparatively little reference to fracture of the neck of the femur in childhood. On the Children's Surgical Service, Bellevue Hospital, we have treated during the past twelve months three cases presenting this type of fracture. A review of the records of this Service for the past ten years revealed only three other children in which a diagnosis of a fracture of the neck of the femur had been made. These six cases are here reported through the courtesy of the Director of the Service, Dr. Carl Burdick.

Fig. 1.—Case II. Original röntgenogram showing an oblique fracture along the cervico-trochanteric portion of the left femur.

The youngest child was five years of age and the oldest sixteen. The fracture in all the cases was produced by severe violence. On admission only a moderate degree of disability was noted in all of the cases, which is quite characteristic of this fracture in childhood and is in marked contradistinction to the extreme disability observed in the adult. Case V, on account of the complaint of persistent pain in the knee, had been treated for several weeks for a "contusion to the knee" and had received during this interval, röntgenograms and strapping of the innocent knee! Three of these cases

* Report presented before the Clinical Conference, Hospital for Ruptured and Crippled, February 23, 1928.

were of the incomplete cervico-trochanteric variety which Taylor has called the "hinge type" and accounts for the slight shortening observed on admission. Two were of the complete cervico-trochanteric type and only in one case was the fracture through the narrowest portion of the neck. This last type is a very rare occurrence in childhood, this patient being only six years of age. Stimson shows in his book a specimen of a case presenting a transcervical fracture reported by Bolton in a child eight years of age. The case reports follow:

FIG. 2.—Case III. Original röntgenogram showing an incomplete fracture at the base of the neck of the left femur.

CASE I.—A boy, age eleven, fell from a truck on August 24, 1919, and was badly bruised. He was brought into Bellevue Hospital, complaining of pain in the left hand and hip. Examination showed that he presented abrasions about the left hip and thigh and movement of the hip caused pain. There was no shortening and röntgenogram of the left hip disclosed a "fracture of the base of the neck of the left femur without displacement." He was anæsthetized and a Whitman abduction plaster spica applied. Two months after admission he was discharged from the hospital walking without a limp and presenting no deformity. A röntgenogram taken several years after injury shows an apparently normal hip-joint.

FIG. 3.—Case IV. A. Original röntgenogram showing an incomplete cervico-trochanteric type of fracture with coxa vara. This patient refused any treatment. The subsequent deformity that developed is shown in the following röntgenogram of the case.

CASE II.—A boy, age ten, on September 5, 1922, while roller skating was knocked down by an automobile and dragged about fifteen feet. He was brought into Bellevue Hospital, and examination showed multiple con-

FIG. 4.—Case IV, 13. This case illustrates most strikingly the results of inadequate treatment. Röntgenogram shows the severe and disabling deformity which resulted.

tusions about the body with pain on attempted movement of the left hip. The limb was rotated outward and there was shortening of one inch. Röntgenogram (Fig. 1) disclosed an "oblique fracture along the cervico-tronchanteric portion of the left femur." The patient was anæsthetized and Whitman abduction plaster spica applied. Following reduction the röntgenological report showed that the anatomical position was excellent. The patient remained in the hospital six weeks and was removed to his home at the request of his family physician. This patient did not return for follow-up but the report one year after the accident states that the child is walking "without limp and appears to have a perfectly normal hip."

CASE III.—A boy, age five, on May 13, 1925, fell from a three story fire escape, injuring his head and left hip. He was brought at once to Bellevue Hospital. Examination showed left hip to be bruised and swollen. The trochanter was not elevated and there was no shortening but the limb was rotated outward, and there was pain on movement at the hip. Röntgenogram (Fig. 2) showed a "fracture at the base of the neck of the left femur, incomplete cervico-trochanteric in type." The child was placed in a Bryant frame with the affected limb in abduction and four weeks later was discharged from the hospital without limp. Examination showed that there was no shortening or limitation of the movements of the hip.

CASE IV.—A boy, age sixteen, on January 9, 1926, fell a distance of about fifteen

FIG. 5.—Case V. Complete transcervical fracture of the neck of the right femur.

feet landing squarely on both feet. He immediately suffered pain in the left hip and was taken home. At this time he was told that he had bruised the left hip and stayed in bed for six weeks without other treatment than rest in bed. At the end of six weeks he became dissatisfied and came to the clinic at Bellevue Hospital, walking with the aid of crutches. He presented at that time pain on movement of the left hip, and one and a half inch shortening and the leg was rotated outward. A röntgenogram revealed an incomplete cervico-trochanteric type of fracture with a coxa vara deformity.

The lad would not enter the hospital and returned home. He was not seen for over a year and then on August 16, 1927, was admitted to the hospital on account of a recent automobile accident. At that time examination of the left hip showed that the left leg was rotated markedly outward, there was elevation of the trochanter and painful restriction with all movements of the left hip. The shortening was three inches. Röntgenogram (Fig. 4) revealed a fracture of the neck of the left femur through an old coxa vara deformity with marked eversion of the limb. In view of the age of this patient it was considered that bony union could be obtained without resorting to bone pegging, therefore the Whitman abduction method was applied and six months after application of the spica, firm bony union resulted.

At present the patient is walking about without the aid of cane or crutches. He has one inch and three-fourths shortening and presents marked limitation in all movements of the hip.

FIG. 6.—Showing result obtained in case shown in Figure 5.

CASE V.—A girl, age six, on May 30, 1927, fell down a flight of stairs injuring her right hip. She stayed in bed for a few days thereafter and then began to limp about, never complaining of much discomfort.

Three weeks after the original injury the child walked into the clinic at Bellevue Hospital, complaining of persistent pain in the knee. She walked with a marked limp, the leg was rotated outward, the trochanter was elevated and there was a shortening of the limb of one inch. There was limitation and pain on all movements at the hip-joint.

FIG. 8.—Case VI. Röntgenogram showing almost complete obliteration of the original fracture. This röntgenogram was taken seven months after the fracture.

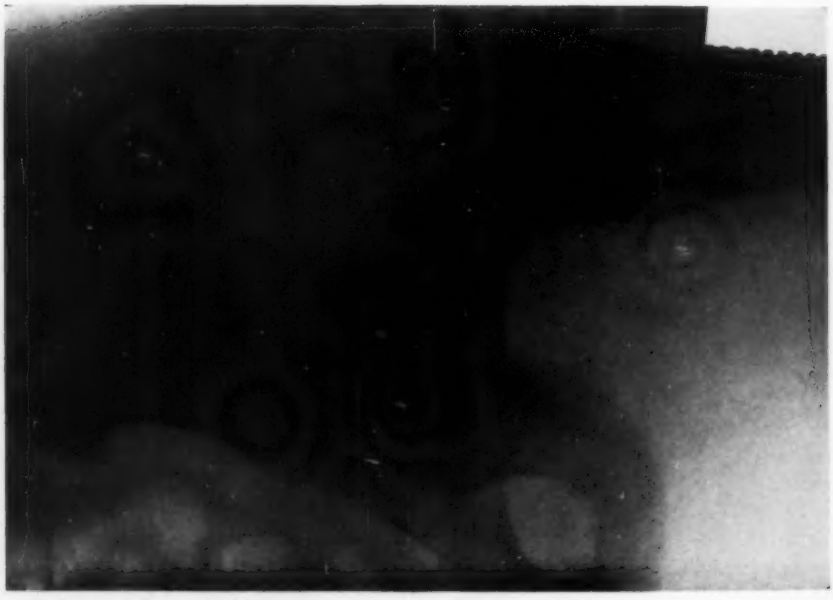

FIG. 7.—Case VI. Röntgenogram showing a complete fracture at the base of the neck of the left femur.

Röntgenograms (Fig. 5) revealed a complete transcervical fracture of the neck of the right femur.

The child was anæsthetized and plaster-of-Paris was applied after the Whitman abduction method. Evidently partial union had occurred at the site of fracture and a complete reduction of the deformity was not obtained. Patient wore this long plaster spica for two months and after application of a short plaster spica with the limb in the original attitude, patient was encouraged to bear weight. Even with the limb immobilized this length of time the callus was not firm and coxa vara developed on weight bearing. The limb was replaced in plaster-of-Paris in the abducted attitude. Plaster removed at the end of four months. At present the patient is walking about presenting the degree of coxa vara shown in Fig. 6. Motions in all directions are satisfactory; abduction is slightly limited and there is shortening of one fourth of an inch.

CASE VI.—A girl, age ten, on August 10, 1927, fell backward out of a window for a distance of six feet, landing on her back and right buttock, was brought the following day into Bellevue Hospital complaining of pain in the right hip. The right thigh was swollen and tender and the hip was slightly flexed and adducted. The trochanter was elevated and there was shortening of one inch. The leg was not rotated outward. Röntgenogram showed fracture at the base of the neck of the right femur (Fig. 7.) Under ether anæsthesia the fracture was reduced following the Whitman abduction method and a long plaster spica applied. Röntgenograms after application of the plaster show the perfect anatomical reduction that was obtained by the use of this method. The plaster was removed after three months and the patient was kept in bed, gradually obtaining full use of the limb, while receiving baking and massage. At present the patient is walking about without a limp. Examination of the hip revealed that the motions in all directions are essentially normal and shortening of only one eighth of an inch. As revealed by last röntgenogram of this case (Fig. 8) the line of fracture is barely perceptible seven months after the injury.

FIG. 7.—Case VI. Röntgenogram showing a complete fracture at the base of the neck of the left femur.

obliteration of the original fracture. This röntgenogram was taken seven months after the fracture.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD MARCH 28, 1928

The President, Dr. Frank S. Mathews, in the Chair

CANCER OF CERVICAL STUMP RESIDUAL TO SUB-TOTAL HYSTERECTOMY FOR FIBROID UTERUS

Dr. Edward D. Truesdell presented a woman who was admitted to St. Luke's Hospital, September 2, 1924, with a fibroid tumor of the uterus. A sub-total hysterectomy was performed. Her chief symptom prior to the operation had been irregular bleeding for nine months. There was no bleeding following the operation until August, 1925, when bleeding occurred which continued for two weeks. The patient then presented herself for examination. The cervical remnant was small, mobile and normal in appearance. There were no masses palpable at either side of the cervix or in the pelvis. The remnant of the cervix was removed, and upon microscopic examination this was found to present an epithelioma of the cervix. Patient is apparently perfectly well at the present time, more than two and a half years after operation.

In connection with this patient, Doctor Truesdell mentioned another who developed vaginal bleeding nine years after a sub-total hysterectomy for a fibroid uterus. This patient failed to return to her doctor until eight months after the bleeding had developed. There was obvious cancer of the cervix in the region of the external os. The cervical stump was removed by combined vaginal and abdominal operation, and apparently with success. However, there was prompt evidence of continuation of the growth, the patient dying some six months later.

DOUBLE EMPYEMA WITH SECONDARY THIGH ABSCESS ABOUT FOREIGN BODY

Dr. Edward D. Truesdell presented a young woman who was admitted to St. Luke's Hospital, June 30, 1924, with a diagnosis of double pneumonia and empyema. There had been an operation for acute mastoiditis two weeks before. It was noted in the history that seven years previously, at ten years of age, this patient had had a fracture of the shaft of the left femur treated by the application of a Lane plate, the plate having been removed six months later. A large empyema of the left chest was drained and a week later a similar condition upon the right side was drained. She was extremely sick, but slowly convalesced and during the course of convalescence a large swelling developed deeply situated in the left thigh and in the region of the old fracture. This was found to contain pus, and a large secondary abscess was drained in this region. X-ray examination showed the presence of a Lane plate screw superficially embedded in the shaft of the femur, which had served as the focus for the development of this abscess. This unfortunate complication occurring in the course of a serious sickness served to illustrate the possible consequences of operative treatment for a fracture of the shaft of the femur in children. Operations in such conditions have usually

seemed desirable because of over-riding of the fragments and the fear of shortening of the extremity, if this over-riding is left uncorrected. Doctor Truesdell said that some six years ago he had presented before the Society five children showing elongation of the femur following fracture. He was then of the opinion, and his observation during these years has supported this opinion, that inequality of the lower extremities following fracture of the femur in children is due to lengthening, rather than shortening, of the injured extremity. For this reason apprehension of shortening can scarcely be regarded as an adequate indication for operative treatment.

MUSCULOSPIRAL PARALYSIS FOLLOWING SUPRACONDYLAR FRACTURE OF HUMERUS

DR. HERMANN FISCHER presented a boy, age five, who was admitted to the Lenox Hill Hospital on August 24, 1927, a few hours after a fall from a height of about six feet, striking the ground with his right elbow. When admitted there was considerable swelling of the elbow-joint with subcutaneous blood effusion, considerable pain, inability of motion and crepitus.

X-ray examination shows a transverse fracture through the lower end of the humerus. The fracture is at the level of the olecranon fossa. The lower small fragment is displaced backward, and there is about one inch over-riding. Two attempts were made to reduce the fragments under narcosis, but were unsuccessful.

Operation, September 12, 1927. Incision about four inches long on the outer aspect of the lower end of the humerus and elbow. The muscles were carefully dissected to avoid injury of the musculospiral nerve, the periosteum was bared, incised and the bone fragments freed with periosteal elevators. Because of difficulty of getting them in proper alignment, a portion of the lower fragment of the humerus was removed. The bone fragments were not sutured, but were held in place by a careful periosteal and muscle suture. Skin closed with interrupted silk sutures. A molded plaster-of-Paris splint was put on holding the arm in extreme flexion and slight outward rotation.

Three days later was discharged from hospital to be treated in the orthopædic department of the dispensary.

Three weeks after operation it was noticed by the orthopædic department that a wrist-drop had developed and the child could not move the arm.

He was readmitted to the hospital and the following status was found: The wound has healed by primary union. There is 30 degrees of motion in the joint. A wrist-drop is present. Can extend end phalanges of fingers, but is unable to move fingers in metacarpal-phalangeal joints.

Diagnosis: Secondary musculospiral paralysis due to pressure of callus on nerve.

October 12, 1927 an incision was made over the site of the old scar, extending for about an inch above it. The muscles were separated until the musculospiral nerve was found. The nerve was freed along its course and in the region of the site of the fracture it was seen to be compressed by callus and scar tissue. The callus compressing the nerve was removed, at the site of compression; the nerve was flattened and had a grayish-yellow color. The triceps was split and the nerve imbedded in its fibres. The skin was then closed with silkworm gut.

The joint was mobilized and put up in extension in an anterior molded plaster splint. The wound healed by primary union.

Since the middle of February the boy has had full function of the arm.

DIVERTICULUM OF BLADDER

Dr. Hermann Fischer presented a man, fifty-four years of age, who was admitted to the Lenox Hill Hospital, November 2, 1927. At that time he complained of vague pains in the region of the bladder and of having to pass his urine a little more frequently than usual. During the last two weeks, however, he had to strain very much to void and occasionally the urine burned him and he had pain in the glans penis on micturition. This straining has caused a slight return of hemorrhoids which he had ten years ago. He never had any hæmaturia.

His past history and his family history are irrelevant. He has been in the hospital twice; once for an ulcer of the leg and at another time for a carbuncle of the arm.

He was a well-nourished male, not acutely ill.

Before his admission to the hospital, he had been cystoscoped by Doctor Asch who had found a diverticulum on the left wall of the bladder near the opening of the left ureter.

Cystoscopy, November 2, 1927. Residual urine, 50 c.c. bladder capacity; 150 c.c. cystoscope was passed with great difficulty on account of a tight narrowing of the prostatic urethra and the internal sphincter. Bleeding was quite profuse. There is present a chronic cystitis with moderate trabeculation. The two lateral lobes of the prostate are slightly enlarged and irregular, leaving between themselves a narrow groove. The ureter openings and the diverticulum, seen by Doctor Asch previously, could not be brought into view on account of the bleeding. The patient refused further treatment and left the hospital unimproved. He was readmitted, November 7, 1927. His condition was unimproved, he suffered more pain and more difficulty in emptying his bladder. November 17, 1927, a suprapubic cystostomy was done under general anæsthesia. On opening the bladder its walls were found moderately hypertrophied. The prostatic gland was very little enlarged, but the internal sphincter was very rigid and fibrotic so that the finger tip could not enter into the prostatic urethra. A diverticulum was found situated above and a little to the left of the left ureteral opening. The depth of the sac measured 2½ inches and the diameter of the mouth of the sac was about ½ inch wide.

A circular incision was made around the opening of the sac, cutting through the wall of the bladder and thus separating the diverticulum from the bladder. Before the incision was made a ureteral catheter was inserted into the left ureter in order to guard against injuring this structure. The mouth of the diverticulum was then secured with a number of Allis clamps and by gently pulling and by blunt dissection with the finger and a gauze-sponge, the diverticulum was easily shelled out from the surrounding perivesicular tissue. A small cigarette drain was inserted into the cavity, around it the wound in the bladder was closed with two sutures of chromic gut; the cigarette drain, together with the suprapubic tube were led out through the cystostomy wound. The cystostomy wound was sutured with chromic gut in two layers around the drain and the tube and the abdominal wound closed around them. Five days after the operation the suprapubic tube and the cigarette drain were removed. The patient made a smooth recovery, his highest temperature after the operation having been 101.2. He was discharged from the hospital with a very small fistula which discharged only a few drops of urine occasionally.

He reëntered the hospital, December 27, 1927, because his fistula had not entirely healed and he still had trouble with his fibrotic sphincter. The

bladder was opened again, January 19, 1928, and the site of the previous diverticulum was carefully inspected. There was no scar to be seen in the interior of the bladder, only a small shallow dimpling could be seen where the old site of the diverticulum had been. The internal urethral opening was enlarged by removing a wedge-shaped piece from its posterior wall by the electric cautery. There was hardly any bleeding. After the operation a No. 28 F. sound passed easily into the bladder. Suprapubic wound was closed around a suprapubic tube and the bladder and abdominal wounds were closed around it.

JEJUNAL ULCER, GASTRO-COLIC FISTULA, FOLLOWING GASTRO-ENTEROSTOMY

DR. HERMANN FISCHER presented a man, age forty-five, who was admitted to the Lenox Hill Hospital for a "diarrhœa" of two months' duration, three to seven daily movements; also occasionally at night. No dietery indiscretion. He lost twenty-five pounds during this time. Appetite very good. No pain or vomiting. He had always been well until seven years ago when he had pain after eating, vomiting with considerable loss of weight. In a hospital in Italy, a pyloric obstruction, caused by an ulcer of the pylorus was diagnosed and a posterior gastro-enterostomy after Hacker was done in 1927. Since that time he has been symptom-free and has worked regularly as a stone cutter. He is a thin, undernourished man. Does not suffer from pain or discomfort. There is a linear scar in midline from ensiform cartilage to umbilicus, well healed and firm. No tenderness, no masses are palpable. The feces give a faint trace of blood. The gastric contents: Free acid, a.c. 16; p.c. 40. Total acid a.c. p.c. 58. Blood negative.

Röntgen Examination: January 14, 1928. The stomach was large in size and somewhat ptosed, the lower border in the erect position extending about four inches below the iliac crest. The stomach presented a regular outline, and the rugæ appeared to be heavy, suggesting some hypertrophy. Peristalsis was very moderately active, and neither under the fluoroscope nor in the serial röntgenograms could a good cap be obtained.

At the sixth hour there was considerable retention in the stomach, the head of the meal reached the mid transverse. At the twenty-fourth hour the meal was distributed throughout the large bowel, which appeared to be quite markedly dilated.

A peculiar factor in this case was the transverse colon being filled with barium before the gastric series was finished, which means that, provided the meal went through its normal course it reached the transverse colon within an hour. A careful check-up on the plates shows no evidence of either a spontaneous or artificial gastro-colostomy. However, the fact that the meal was in the transverse colon so rapidly indicated some pathology in this region, and the possibility of a perforation between the duodenum and the hepatic flexure.

January 27, Röntgen examination of this patient by means of a clysma presents a very striking appearance. The medium passed up through the sigmoid, descending colon, and transverse colon as far as the hepatic flexure. From this point the stomach filled up and immediately began to empty into the small bowel so that we had the appearance of the large bowel lying under many loops of small bowel filled with barium, and the stomach completely filled out, as was seen in the plates taken at the gastro-intestinal examination.

January 31, Röntgen reëxamination of the stomach of this patient showed a gastro-enterostomy functioning actively. This could not be made out at

the previous examination. From here the transverse colon filled up. The appearance at the present time suggests the communication to be in relation to the gastro-enterostomy rather than to the duodenum.

Clinical diagnosis: Gastro-colic fistula, caused by jejunal ulcer following a posterior gastro-enterostomy.

Operation, February 4, 1928. Midline incision from ensiform process to umbilicus. Many adhesions between stomach and anterior abdominal wall which had to be separated; there was also extensive adhesions between the large curvature of the stomach and the transverse colon and upper ileum. On turning the stomach upward an inflammatory mass was found which was made up by the posterior wall of the stomach, the afferent and efferent loop of the jejunum and the transverse colon, all matted together by firm adhesions. After careful dissection a fistula of the tranverse colon was found of the diameter of a pencil which led into the stomach at the site of the gastro-enterostomy stoma. The afferent loop of the jejunum was markedly hypertrophic and dilated, whereas the efferent loop was contracted and its lumen considerably smaller than that of the afferent loop. The region of the stoma itself was hard and inflamed and was the seat of a chronic ulceration. The fistula in the colon was excised and the gut was sutured. The loop of jejunum was dissected away from the stomach and the ulcerated margins of the jejunum and the stomach were also excised. The defect in the stomach as well as the defect in the small gut were closed by a double row of chromic gut.

The pylorus was the seat of cicatricial contraction, the original ulcer having healed. Therefore a pyloroplasty after Finney was done.

The patient made an uneventful recovery and is well since the operation.

Pathological report: The walls of the stomach and gut are congested and œdematous, and show inflammatory cell-infiltration. The mucous membrane in the region of the anastomosis shows superficial erosions apparently involving the gastric portions. There is no evidence of malignancy.

THE USE OF OX FASCIA IN THE OPERATIVE TREATMENT OF HERNIA

Dr. Henry W. Cave presented a woman, thirty-three years of age who was admitted to Roosevelt Hospital, October 21, 1927, for treatment of a ventral hernia. She had undergone an emergency operation for extra-uterine pregnancy in July, 1926; developed a hernia in the lower end of the wound two months later and after two weeks had another operation for repair of incisional hernia—both of these operations were done in a neighboring hospital—eight months later, she noticed the hernia had recurred in the same place. Has been wearing a belt since first operation. Until the past two months she has also been troubled with constipation and occasional nausea and vomiting. Onset of menstruation since July, 1926, has been quite painful and also since this time she has lost about twenty-five pounds in weight.

When admitted to Roosevelt Hospital there was a midline scar about 6 inches long below the umbilicus, in the centre of which is an opening which admits easily the thumb and through which a small knuckle of intestine tends to protrude when patient coughs—vaginal examination: there is a thickening in either fornix particularly on the left—the uterus seems tender and slightly enlarged.

October 24, 1927, the scar was excised and the loops of the intestine adherent in the sac and around the hernial ring were freed. In examining the abdominal viscera it was discovered that there was a large mass in the region of the left tube and ovary, a typical left tubo-ovarian abscess. This was removed without soiling. A side-to-side closure was then done and a

good part of the tissue which had formed the sac had to be utilized for the muscles to either side were very thin and frayed; over this side-to-side overlapping procedure which was done with interrupted chromic catgut sutures, a strand of ox fascia suture was interwoven back and forth across the defect; widely spaced interrupted silkworm sutures closed the wound.

She made an uneventful recovery. Except for a seepage through the lips of the wound of the Scott's solution in which the fascia was preserved, there was nothing interesting to note. Temperature rose to 101; first day post-operative; reached normal on the fourth day. In bed twenty-three days. Patient states that occasionally she has a pain in the right lower abdomen—digestion and bowels are regular—wound perfectly healed—when patient coughs or strains no bulging in the region of the scar either generally or locally.

Doctor Cave then presented a man, aged forty-one, who was admitted to Roosevelt Hospital, January 10, 1928, four months after having undergone operation for a bilateral inguinal hernia. Soon after he was discharged from the hospital he noticed a bulging in the region of the left external inguinal ring—this bulging area has become gradually larger.

When admitted there was a protrusion in the region of the lower angle of the scar on the left side and a very definite impulse is seen and felt on coughing near the pubic spine—without question it is a recurrent indirect inguinal hernia. January 11, 1928, repair of recurrent left indirect inguinal hernia; retransplantation of cord; suture with ox fascia.

Incision was made excising the old scar, fascia of the external oblique was identified and cord isolated, the sac identified, freed and found to be of moderate size, transfixed and ligated and excised. The opening was quite large and the internal oblique muscle was hardly perceptible, its fibres being thin. A strip of ox fascia was used weaving it back and forth from what remained of the internal oblique muscle to Poupart's ligament, cord transplanted, external oblique sutured over cord, closure of the wound with interrupted widely spaced silkworm gut sutures.

The patient's temperature rose to 102.6 first day and gradually subsided to normal by the fifth day, a very normal course thereafter, out of bed on the nineteenth day, discharged on the twenty-second day.

The man states that March 14 there appeared through a gap in the scar at the lower end of the wound a little pus. A few drops of pus have been discharged through this opening during a period of three days, apparently a small abscess had formed at the lower angle of the wound, probably where the end of the suture was last tied—ring however firm, no evidence of any recurrence.

Doctor Cave added that these two patients were presented to show the moderate local and general reaction following the use of a dead fascial suture. Sufficient time has not elapsed to assume a cure as all his cases (four) have been operated upon within the past year. Except for (1) seepage through the lips of the wound of the preservative (Scott's solution) and (2) a small sinus persisting for a few weeks in one instance, which in all probability was due to the use of linen anchoring the end of the ox fascia suture, and (3) to a latent abscess which was of three days' duration in the last case presented, they have done as well as the ordinary hernia patient does following the use of any other type of suture. There was practically no induration even in

the instance of the linen suture sinus or in the instance of the short lived latent abscess.

The use of an ox fascia suture does away with an additional incision in obtaining fascia, as is done in the Gallie operation; no time is lost in obtaining a strand; a longer strand can be had than that which is obtained ordinarily in the McArthur procedure, especially in the instance of the operation for recurrent inguinal hernia.

Koontz in Baltimore, following Nageotte, who transplanted pieces of alcohol preserved tendon to repair anatomic defects in tendons of living animals, has applied this same principle by the use of ox fascia in the cure of hernias. The histologic change that takes place is interesting. These grafts although dead do not act as foreign bodies, nor are they absorbed. The wandering cells of the host carry away the dead cells of the graft, the fibroblasts of the host invade the connective tissue framework structure of the graft and form living cells in the place of the dead cells of which the graft was composed. Then follows the establishment of a new circulation in the graft so that after a surprisingly short time the graft cannot be identified as a dead graft but appears, macroscopically, and microscopically, as a component part of the surrounding tissue. It has been asked why these ox fascia sutures are not exactly similar to the chromicized kangaroo tendon which were considerably used in former years and the chromicized catgut that is now used. Koontz maintains that the strands of kangaroo tendon and catgut are treated chemically, facilitating increased absorption, also that they are so twisted that the fibroblasts from the host cannot invade them, therefore they are absorbed by the host. Koontz has done seventeen hernias using ox fascia, up to last October. In two of his cases infections developed which he later proved to be due to the presence in the strips of fascia of nonpathogenic spores that had not been killed out by the preservative fluid. The total number of patients in which he had used ox fascia suture material have been eight.

Dr. Carl G. Burdick presented three groups of patients representing the different types of inguinal hernia in which he felt fascial sutures were indicated.

In the first group there were two patients past middle life with large scrotal hernias of long duration and pendulous abdomens. In this type of hernia which is usually of long standing the inguinal canal has lost its obliquity, and the internal ring much enlarged and relaxed lies almost directly behind the external ring.

The first patient was operated on in July, 1927, at the age of fifty-seven, for a large scrotal sac which contained irreducible small gut and omentum, this was reduced with considerable difficulty after enlarging the internal ring by division outward. He developed a late infection which did not appear until a week after leaving the hospital. The wound discharged for several weeks but only a slight amount of his fascial sutures sloughed.

The second patient was operated on January 7, 1928, at the age of sixty-one, for a large scrotal hernia of forty years' duration. The posterior wall was very relaxed and to insure a more satisfactory closure the cord was

divided. Due to the adhesions of the sac there was a large area of induration above the testicle which is gradually subsiding.

The direct hernias represent a second group in which a fascial repair is indicated as giving a higher percentage of cures than any other method. With an absence of the conjoined tendon and a very weak transversalis fascia, this defect cannot be repaired satisfactorily in any other way in a fair proportion of the cases.

The first patient age forty-two, had a saddle-back type of sac with the direct part of the sac predominating. He was operated on in January of this year and while it is entirely too soon to say what his final result will be, he is presented as an example of this type of case.

The second patient, age thirty-eight, was operated on in April, 1927, for a double direct hernia, right, size of egg, left impulse. He developed an infection in his left wound which discharged for several weeks and the major part of his fascial sutures sloughed out. Two months ago he developed a recurrence on that side. Of a dozen cases which became infected, and in a few parts of the sutures have sloughed, this is the only recurrence which can be attributed to that cause.

Recurrences form the third group in inguinal hernias and in these patients a fascial repair is always done.

The first patient age thirty-five, was operated on six years ago for a right indirect inguinal hernia which recurred six months later. He was operated on in January and an indirect recurrence found. It is entirely too early to prognosticate a permanent cure, but from the feel of his scar one is quite confident that the result will be satisfactory.

The second patient was fifty-nine years of age when operated on in April, 1926. He had been operated on five times before in as many years, the last two operations having been performed by New York surgeons of unusual ability. A left direct sac the size of an orange was found with practically no posterior wall to his canal. Obviously this defect could not be repaired without the aid of fascial sutures. Two rows of sutures were used in the repair. The first suturing transversalis fascia, transversalis muscle and internal oblique muscle to Poupart's. The second suturing the external oblique behind the cord. He has remained cured up to the present time.

FASCIAL SUTURE IN THE OPERATIVE TREATMENT OF INGUINAL HERNIA. (A PRELIMINARY REPORT)

Dr. Henry H. M. Lyle read a paper with the above title for which see page 870.

Dr. Carl G. Burdick said that the advantages of sutures over fascia lata graft had been demonstrated by Gallie who found that the union of the graft to the adjacent structures was by areolar on scar tissue, and while the graft itself might offer enough strength the weak point lay in its union to the adjacent tissues. If a firm bite of the tissue was secured with the fascial suture this latter ultimately became a strong fibrous cord and held the tissues approximated securely.

While he had used some ox fascia he felt that the latter was far from satisfactory at present. Doctor Koontz had demonstrated satisfactorily that dead fascia provided a satisfactory suture material and later became organized in the tissues accomplishing the same results as the living sutures, but at present the sutures are very friable and poorly cut. As soon as these dis-

advantages have been obviated there was a broad field for the ox fascia. At the Hospital for Ruptured and Crippled they had been in the habit of preserving the extra living sutures in Scott's solution comprised of, alcohol 55, acetone 10, mercurochrome 2, distilled water 34, and when a case presented in which living sutures had not been obtained they used these preserved human sutures and have had satisfactory results with these.

Doctor Burdick disagreed with Doctor Lyle in regard to not overlapping the external oblique behind the cord, but if done it was essential to close the muscles tightly about the cord as it undoubtedly left a weak spot at that point in as much as the cord emerged through both layers of muscle at the same level.

Doctor Burdick had seen about a dozen late infections. These usually came on after leaving the hospital, in a few about the tenth day. What the cause was he did not know. Usually some of the fascia sloughed but only one case has been followed by a recurrence.

Personally he has operated on 149 inguinal hernias by this method in the past four years in the following groups indirect 45, indirect with direct weakness 14, direct 61, recurrent 29. While these cases have not been followed as carefully as Doctor Lyle's he has observed the following recurrences; three indirect with direct weakness, one recurrent, one direct with sloughing of the fascial sutures due to infection.

Dr. Morris K. Smith said that reports of the results in hernia repair with living fascial sutures deal largely with more difficult cases. Unquestionably these are the cases in which they are particularly indicated. Yet a comparison of the two types of suturing in the ordinary adult male hernia is of great importance first because it gives an index of the reliability of the method and second because results in ordinary inguinal hernia are not yet wholly satisfactory. Doctor Lyle's series, while it contains a higher proportion of the more difficult types of hernia, because he started the fascial suture in these cases, yet represents to a considerable degree the routine hernia work of the hospital as he began its employment some time ago in all adult males.

Doctor Smith had followed his lead in this matter and had been interested at this time to sum up his own results from the follow-up reports. Using a year's follow-up as the minimum except for such cases as have presented a recurrence earlier he had a series of fifty-five repairs with 10.9 per cent. recurrences in which catgut sutures were used as opposed to thirty-four repairs with 2.9 per cent. recurrences in which fascial sutures were used. Summary follows.

Inguinal Hernia.

	Catgut	Fascia
Indirect	39 (37 patients)	21
Direct	12 (8 patients)	10 (9 patients)
Recurrent	4	3
	55	34

Inguinal Hernia.

	Catgut	Fascia
Recurrences		
Indirect	4	1
Direct	1	0
Recurrent	1	0
	6 — 10.9%	1 —2.9%

It is perhaps only fair to say that the catgut series was done earlier and therefore represents a longer follow-up, as well as a less mature period in operative experience.

Of the fascial suture cases the Gallie was done in the recurrent herniæ and the McArthur in the remainder.

These series are obviously too small to have much weight and yet they indicate a decided advantage for the fascial suture.

The one recurrence in the fascial sutures series was in an indirect hernia in which the cord had been brought directly out subcutaneously. At reoperation the recurrent sac followed out along the cord while the union of the conjoined tendon to Poupart's at its inner side was firm. Doctor Smith now feels as Doctor Lyle does that suturing the aponeurosis of the external oblique behind the cord is unsound, surrendering the protective effect of the natural obliquity of the canal through the supporting structures of the abdominal wall.

In deciding for or against the fascial suture method in hernia its applicability must be weighed. The McArthur suture requires a longer incision and more time but the difference is small after a little experience. The speaker had not found the McArthur method applicable to recurrent hernia owing to the scarring of the aponeurosis of the external oblique. In these cases and in the more difficult direct herniæ the Gallie should be used.

Dr. Alexis V. Moschcowitz stated that he had performed a very fair number of operations for the radical cure of hernia without having to take recourse to the Gallie technic; he was not even tempted to do so. Furthermore, both he and his patients were satisfied with the results obtained. Doctor Moschcowitz does not wish to say that the Gallie technic has no place in surgery, but he does believe that the indications for it are very rare and that it should be restricted to those cases in which there is a loss of substance resulting in a large defect in the abdominal wall; in other words, there is no frequent indication for it in the inguinal and femoral varieties of hernia.

For a number of years Doctor Moschcowitz has discarded entirely the use of muscle for the repair of inguinal hernia. For the sake of better technic he goes so far as to extirpate the cremaster muscle entirely and when the internal oblique and transversalis muscles present themselves in the wound, he has them retracted. In other words, Doctor Moschcowitz uses for the repair of hernia only the aponeurosis of the external oblique and Poupart's

ligament. In femoral hernia he utilizes only Poupart's ligament and Cooper's ligament.

Doctor Moschcowitz assumes that he has had just as many recurrences as other surgeons, but in a careful follow-up of his private patients he has seen but one definite recurrence, and even that was not a bona fide recurrence because the new hernia was of the femoral variety.

Up to June, 1927, Doctor Moschcowitz was extremely partial to kangaroo tendon in the repair of hernia. He has, however, seen so many infections follow its use that, although no patient developed a recurrence, he has abandoned its use entirely and is again using chromicized catgut.

Dr. William Crawford White said that he had reserved the use of living fascia suture for the more difficult cases, and in these the aponeurosis of the external oblique was practically always so weak that it was necessary to use fascia lata. In fifteen cases followed over two years he had had three slight recurrences. But it must be remembered that these cases were of the desperate type and with the old methods would have given a higher recurrence. Doctor Lyle's most interesting observation was that he has convinced himself by his results that the routine use of living fascia has reduced the percentages of recurrences that he formerly obtained with a similar technic and the use of catgut.

Doctor Lyle, in closing, said that the McArthur technic is so simple when mastered that it only takes a few minutes longer than suturing by catgut. A study of the recurrences in the Halsted modification has shown that it violated the physiological principle of muscular control of the inguinal canal. The external ring is brought close to the internal and the obliquity of the canal destroyed. In addition the bringing out of the cord so straight offers a mechanical barrier to the proper shutter action of the arched fibres of the internal oblique and keeps them from coming down into the proper protective position over the cord and internal ring. A secondary reason is that it also hampers the gliding mechanism of the external oblique muscles in its valve-like closure and consequently does not as effectively raise and set Poupart's ligament. This is an important factor in an overhanging abdomen. They were now using some form of fascial suture as a routine and so far they had found it more reliable than catgut. Regarding Doctor Moschcowitz remarks about suture of the transversalis fascia being sufficient for all cases, he did not agree with him.

Doctor Lyle said he takes particular care to obtain a functional closure of the transversalis fascia but in addition he added every detail which he thought would give a stronger functioning inguinal closure. In many of the different cases the transversalis fascia could not be found or was useless as a barrier. In these cases it is idle to say that the suture of the transversalis fascia would cure the hernia. He reminded Doctor Moschcowitz that it is possible also to cure hernia without any suturing. In the middle ages there was a monastery which had obtained fame for curing hernia and the patients

flocked from all Europe for treatment. After scarifying the hernial region the leg was flexed on the abdomen and the knee bound to the opposite shoulder; the patient was kept in this position until firm union was obtained. This position relaxes Poupart's ligament, the external oblique, the internal oblique and conjoined tendon, the recti and healing took place without suture. He would not advocate this as a sound procedure, nor did he believe it would ever become a very popular one.

In conclusion he said that one cannot expect a fascial suture to take the place of sound surgery and he did not wish for a moment to leave that impression. The endeavor is simply to find out if its use will improve results. He was conscious that in having his attention more closely focused on the subject he might unconsciously be more painstaking in these cases. He emphasized the fact that no case under eighteen years of age is included in this series.

STATED MEETING HELD APRIL 11, 1928

The Vice-President, Dr. Edwin Beer, in the Chair

POST-OPERATIVE MASSIVE COLLAPSE OF LUNG

Dr. Charles E. Farr presented a boy four and one-half years of age, who entered St. Mary's Free Hospital for Children, November 14, 1927. He had been ill twenty-four hours with typical signs and symptoms of a severe appendicitis and spreading peritonitis. Operation was performed at once under ether narcosis by the open cone. The appendix was gangrenous and there was a wide-spreading peritonitis. The wound was left wide open and drained with the Gibson-Mikulicz tampon. It was noted that during the anæsthesia there was considerable cyanosis. The following day there was a very sharp reaction. The peritonitis seemed, however, to account for this. There was some cough, considerable dyspnœa and a moderate cyanosis. On the third post-operative day there was a very marked degree of shock. The temperature rose to 106.6, the pulse to 160. The cyanosis and dyspnœa was very great.

Physical examination showed on inspection a much less expansion of the right thorax. Marked hyper-resonance of the left chest. Displacement of the heart to the right, and many changing signs in the right chest. Dulness, bronchial breathing, moist and dry râles were scattered indiscriminately apparently. The clinical diagnosis of massive atelectasis was made. The child, who had been in the Fowler position was then laid flat, turned on the sound or left side and restrained in that position. He fought vigorously against it, and coughed considerably. In two hours his temperature had dropped from 106.2 to 102.2, and the pulse from 160 to 124. He was very much improved. Oxygen was administered to relieve the cyanosis and this also aided. The following day temperature dropped to 101 and the pulse to 120, and he made an uninterrupted recovery; the peritonitis slowly subsided and wound healed in about three weeks. He was able to leave the hospital in four weeks and is now perfectly well.

X-rays, taken on the fourth post-operative day, showed collapse of the right lung almost complete, with the heart, mediastinal contents and trachea, displaced to the right, and a very marked expansion of the normal left lung. X-rays taken on the fifth post-operative day, two days after the onset of the collapse, showed the heart in a midline practically normal position, almost

complete clearing of the right thorax, trachea in the midline, and the left lung normal. X-rays taken ten days later showed complete return to normal.

This case was presented as being the only one of massive atelectasis in a child which has been recognized. It is highly probable, however, that many other instances have passed as pneumonia, bronchitis, etc. Unless X-ray is taken promptly at the onset of symptoms the diagnosis is apt to be missed.

Doctor Farr then detailed the histories of two more cases of massive collapse of lung from the service of Dr. Charles L. Gibson, of the New York Hospital, First (Cornell) Surgical Division.

Michael F., twenty-one years of age, entered the hospital, January 13, 1928. He was operated upon for recurrent attacks of appendicitis. He was given a general anæsthetic of nitrous oxide and ether without other medication. There was nothing noteworthy in the course of the operation. On the first post-operative night there was a cough, increase in temperature and respirations, with some cyanosis. Diagnosis of massive collapse was made by means of clinical signs and was confirmed by X-ray, which was taken on the second post-operative day. The report reads: "Examination of the thorax shows marked opacity of the entire left chest and quite marked deviation of the trachea, heart and mediastinum to the left side. The findings indicate a massive collapse."

The House Surgeon, Dr. Wade Duley, on his own initiative, placed the patient on the right, or sound side, and slapped him vigorously on the left, or affected side. The patient became very cyanotic, gagged and coughed up a large amount of mucus. The condition immediately began to improve, and an X-ray taken thirty minutes later showed a very definite clearing of the shadow of the left lung, indicating that the lung had become aerated. The trachea was almost in the midline, the cardiac shadow was still displaced to the left. X-ray taken the following day showed some mottling in the left lung still present. The cardiac shadow was still somewhat displaced to the left. The trachea was almost in its normal position. The massive collapse had been relieved and had not returned. This patient made an excellent post-operative recovery and left the hospital on the tenth post-operative day with wound soundly healed.

The second patient was a young man, twenty-eight years of age, who entered the New York Hospital for acute appendicitis of twenty-four hours' duration. He was operated upon at once and an appendectomy was performed. There was no pre-operative medication. He was given nitrous oxide and ether by the closed method. The operation lasted fifty minutes. There was no noteworthy occurrence during or immediately after the operation. Twenty-four hours later his temperature rose to 103.2, pulse 116, and he became cyanotic and showed dyspnœa. The typical signs of massive collapse of the right lung were present. By X-ray the clinical diagnosis was abundantly confirmed. The right lung was collapsed, the trachea was well to the right side, heart almost entirely in the right chest, and the left lung was compensating. The patient was then turned on his left or sound side and the thorax struck sharply with the palm of the hand. There was no distress, but he coughed up a considerable plug of thick mucus. The relief was immediate. He was kept fifteen minutes on this side and coughed up a little more mucus. X-ray taken thirty minutes after the first X-ray showed the trachea in the midline, heart in normal position, right lung completely aerated, left lung normal. A plate taken twenty-four hours later confirmed the complete recovery.

Doctor Farr presented these latter two cases as instances of the severity of the condition known as massive collapse or massive atelectasis. Of the nine cases which have been observed in the service of Doctor Gibson, who fortunately have been healthy young adults and mostly males, there have been no deaths, but the morbidity has been prolonged seven or eight days. The condition is most distressing to the observer and to the patient. This manœuvre of Doctor Duley's has immediately cleared up the state of massive collapse and has returned it to a normal post-operative condition.

SARCOMA OF BREAST FIVE YEARS POST-OPERATIVE

Dr. Carl Eggers presented a woman who, when forty-seven years of age, was admitted to the Lenox Hill Hospital, complaining of a swelling in the left breast which had gradually developed during the last six months. There had been no pain and no discharge from the nipple. There was no history of injury to the breast. She had, in her early life, nursed two children but had had no trouble with her breasts at any time. Past and family history had no bearing on the condition. Examination showed a fairly healthy woman with no disease of the internal organs to be made out.

The right breast was small and soft and showed no abnormality. The left one was large; it hung lower than the right, and the superficial veins were dilated. There was no retraction of the nipple. Palpation showed a large, hard tumor occupying the entire anterior portion of the left breast. It had none of the signs of carcinoma of that size. There was no discharge from the nipple and the axillary lymph-nodes were not enlarged. There was one area of softening in the tumor about the size of a walnut which was interpreted as due to cystic degeneration. On account of the lack of elevation of the breast; the absence of retraction of the nipple; the absence of pigskin appearance; the presence of large veins; and the absence of axillary lymph-nodes; the probable diagnosis of sarcoma of the breast was made.

Operation was performed September 13, 1923; the usual radical mastectomy procedure was carried out, removing both pectoral muscles and the axillary contents. It was possible to approximate the skin edges and get a good suture line. One split tube rubber drain was inserted into the axilla through a stab wound.

The patient made an uneventful recovery. The wound healed by primary union and she was discharged fifteen days after operation, entirely healed.

The pathological examination showed a spindle-celled sarcoma of the breast originating in the stroma of an intracanalicular fibro-adenoma. The following is a detailed report of the microscopical examination: Sections obtained from different parts of the tumor show an intracanalicular fibro-adenoma, the stroma of which is very cellular and in places has undergone sarcomatous degeneration. In a part of the tumor the epithelium is fairly abundant and the intracanalicular fibrous plugs and the surrounding stroma are very cellular and show myxomatous changes. Large areas of the growth are devoid of epithelium and consist of spindle cells which are either loosely arranged or are packed close together. In areas they are arranged in bundles which often anastomose with one another. The tumor cells show a general uniformity in size and but little irregularity in staining properties. Here and there are slightly larger and more deeply staining cells. Mitotic figures are not uncommon. The tumor shows considerable œdema and areas of mucoid degeneration.

The patient has been seen in the last few years at regular intervals at the Follow Up Clinic and at no time has there been any evidence of further involvement. She has remained well except for the development of a toxic

adenoma of the left lobe of the thyroid for which she was subjected to operation April 9, 1927, under local anæsthesia. She made an uneventful recovery.

RESECTION OF SIGMOID FOR ACUTE SIGMOIDITIS AND DIVERTICULITIS

Dr. Carl Eggers presented a man who was first seen by him in November, 1923. The man was then forty-four years of age. He complained of attacks of pain in the left lower abdomen which he had had on and off for a number of years. During the last six months they had been more frequent. The pain was quite severe and remained localized in the region of the descending colon. It was never accompanied by vomiting. Bowels were fairly regular, but lately his stools had not been well formed, they had been thin and ribbon-like. He had not noticed blood. He had much trouble with gas which seemed to stick on the left side. There had been no loss of weight.

General examination was essentially negative. The abdomen was not distended. There was a little tenderness over the left lower quadrant but no tumor could be felt. Rectal examination was negative.

A diagnosis of malignancy or diverticulitis was considered and he was sent for Röntgen examination with the following result: There was no evidence of obstruction to the inflow of the barium mixture. The patient was able to retain the usual amount of fluid without any appreciable discomfort. Fluoroscopy and plates showed no evidence suggestive of any neoplasm, but presented evidence of very great spasticity and tenderness along the descending colon. Evacuation of the enema fluid was good. The appearance of the junction of the sigmoid and the descending colon was suggestive of diverticulitis.

(Barium Meal 24 hours p. c.) Typical appearance of diverticulitis of sigmoid and lower part of descending colon. Moderately diminished motility.

Conclusions: Diverticulitis of junction of descending colon and sigmoid causing marked spasticity of the descending colon and partial obstruction to the Barium mixture given per os.

After this diagnosis of diverticulitis had been established advice was given him about diet and proper care of the bowels. He was not seen again until a little more than three years later when he was admitted to the Lenox Hill Hospital, December 2, 1926, complaining of pain in the lower abdomen, which had started suddenly two days before at 3 A.M. The pain was sudden, severe and sharp; it was located in the lower abdomen just above the bladder. He got up and urinated and moved his bowels a little. The bladder was somewhat relieved but the pain remained severe. He did not vomit. He went to business the next day but returned early in the afternoon on account of severe pain. Was seen by a physician who made a diagnosis of acute appendicitis. When there was no improvement with conservative treatment the man was sent to the hospital. There was no urinary disturbance. He had had a chill the day before admission.

On admission he gave a history of frequent attacks of pain in the lower abdomen since last seen by the reporter three years before, but none as severe as the present one. His tongue was coated but moist. Heart and lungs were negative. The abdomen was distended, no organs were palpable. There was marked tenderness over the entire lower abdomen with rigidity which seemed most marked over the lower right rectus. There was no tenderness over either iliac fossa. Rectal examination was negative. Temperature 100.8. Pulse 96. White blood cells 16,400, polymorphonuclears 74 per cent. Immediate operation was advised and performed that evening.

A five-inch suprapubic incision was made just to the right of the median

line. A large injected appendix was exposed and removed. The sigmoid was then exposed. In the upper part it looked fairly normal, but attached to it were several diverticulæ containing hard concretions. On following the gut downward free turbid fluid was encountered. Later culture showed this to contain colon bacilli and hemolytic streptococci. This fluid surrounded a hard mass situated in the sigmoid at its lower end or near the upper end of the rectum. It was about the size of a tangerine and very hard. After exposure it was found to be acutely red and the fat overlying it œdematous. It was covered with fibrin deposit. Adherent to it was a loop of small intestines, likewise covered with fibrin. It did not seem wise to separate the fat from the sigmoid for fear of causing a perforation. A cigarette drain was therefore placed on the outer side of the inflammatory mass and brought out of the lower end of the wound. The loop of small intestine was separated from the tumor and the omentum placed over the entire mass of coils of small gut, thus separating them from the tumor. Abdomen closed in layers.

The convalescence was quite stormy for a few days on account of a complicating broncho-pneumonia affecting the right side. Sero-purulent drainage from the wound continued for a while and the drain was gradually shortened and finally removed December 14, twelve days after operation. The patient was discharged cured December 25, 1926; twenty-three days after operation.

During his stay in the hospital, a barium clysma was given which showed marked diverticulitis of the sigmoid.

The patient was seen from time to time after operation. He continued to have severe attacks of pain over the lower abdomen, lasting for several hours at a time. There was never any blood. He was never entirely free from pain and was unable to lie on the affected side. He was finally readmitted to the Lenox Hill Hospital March 1, 1927, about three months after his last operation. That evening he had another attack of excruciating pain accompanied by a state of shock which looked alarming. After he had recovered from that, radical operation was proposed and done, March 4, 1927.

A left rectus incision about seven inches long was made. No free fluid present. No adhesions found as the result of the recent attack of peritonitis, except that the omentum was somewhat adherent to the scar. Exposure of the affected area was rather difficult because the lower end of the omentum was adherent to the tumor mass, and the latter was also adherent to the lateral pelvic wall. The sigmoid was then drawn upward and all adhesions freed. One small abscess was then entered, evidently due to perforation of one of the diverticulæ. For a distance of about four inches the sigmoid felt infiltrated and hard, as if it contained a tumor, but it was acutely red as at the previous operation. About five inches of the sigmoid were resected, staying close to the affected portion in order to be able to do an anastomosis later. One long diverticulum, not inflamed, happened to be in the line of incision. It was dissected out and sent to the laboratory. The ends of the gut were then united by silk sutures, using continuous for the inner layer and interrupted for the outer one. Good approximation was obtained. One cigarette drain was inserted on the outer side of the anastomosis.

The post-operative course was very satisfactory for the first few days except for a persistent cough. He passed gas within the first twenty-tour hours. His abdomen was soft and there was only moderate sero-sanguineous drainage from the wound, without odor. A pneumonia developed at the right base and was associated with distressing cough. On the morning of the fifth day the patient began to complain of severe pain on the left side of the abdomen. His pulse was 120 and the abdomen was distended, whereas the day before it had been soft and the pulse slower. There was moderate

amount of discharge. He had desire to move his bowels. Rectum contained much feces. An irrigation gave a good result. There were several small movements afterward. Some of the fluid came out of the drainage wound above. He began to vomit. Obstruction was suspected, probably due to separation of fascia as the result of constant cough. The skin sutures had held intact, but a few were removed and inspection showed bulging of the gut. The entire skin wound was therefore reopened later in the day, exposing retracted fascia and bulging loops of gut matted together. They were cleaned, iodoform gauze was laid over them and then a plain gauze tampon. The wound edges were firmly strapped. Gastric lavage given. Hypodermoclysis. Patient looked bad. No passage of gas.

The following day the condition was somewhat improved. There were several small bowel movements, but the abdomen remained distended. He vomited frequently, but it was not fecal. The next day conditions were decidedly better. Bowels moved and vomiting ceased. Some fecal discharge presented at the wound, and a drainage tube was therefore inserted to replace the cigarette drain. Convalescence was uninterrupted after that. The separation of the wound required considerable attention. The patient was in no condition to stand a secondary suture and it is questionable whether it would have held. Holding the gut back by means of a narrow tampon and strapping the wound edges snugly over this gradually led to healing with a good firm abdominal wall. The patient was discharged cured April 3, 1927. He has since been well and has had no further attacks of abdominal pain.

An X-ray taken of his colon showed slight narrowing at the site of anastomosis, but no obstruction, and the bowels were in normal position and presented an entirely regular outline. On defecation excellent emptying took place.

The examination of the specimen showed the wall of the sigmoid much thickened and firm in feel. Pressure on it caused exudation of fecal masses from many diverticulæ. After emptying them, little everted openings like mouths were visible on the mucosa.

Microscopical examination showed two kinds of diverticulæ, true and false, the former having all the coats of the intestines represented in their covering, while the latter had walls consisting of mucous membrane, a definite musculous mucosa and outside of that a zone of fibrous tissue. There were also areas of suppuration surrounded by dense inflammatory fibrous tissue containing bundles of smooth muscle, and groups of foreign body giant cells were found. The gut wall was much thickened by fibrosis and localized hyperplasia of the smooth muscle.

RESECTION OF STOMACH FOR JEJUNAL ULCERS AND OTHER COMPLICATIONS

Dr. Carl Eggers presented a man who, when forty years old, came under observation October 24, 1924, on account of abdominal pain. He gave a long and complicated history. For many years he had been troubled with pressure sensation and fulness in the upper abdomen which never completely yielded to medical treatment. There was no vomiting and he had never had pain. About seven years ago he came under the care of a surgeon who made a snap diagnosis of ulcer, and without Röntgen or other examination operated through an epigastric incision. After operation the patient's wife was informed that an ulcer had not been found, that there was nothing serious, and that the appendix had been removed. Thirteen days after operation he was reoperated for what was diagnosed as intestinal obstruction. After

recovery from this he felt relief for several months, but then developed pain in the epigastrium regardless of whether he ate or not. There was much nausea but no vomiting. Medical care gave no relief. After a few years he gradually became worse. About two years ago he was operated on by another surgeon, also without previous X-ray examination. At this time the pylorus was resected and the open end implanted into a loop of jejunum. He was discharged two weeks later, but on account of constant vomiting he had to return to the hospital three days later when another operation was performed and an entero-enterostomy done to overcome a vicious circle. Since this last operation the patient had not had one comfortable day. He had pain all the time which during the last four months had become so bad that he was hardly able to walk. Pain was felt in the epigastrium and back. Fasting relieved it somewhat, but about one-half to three-quarters of an hour after meals it became excruciating. It was always worse at night than during the day. He had a great deal of belching, but no sour eructations, and no regular vomiting. His bowels were constipated and moved only every two or three days, with laxatives or an enema. He had lost fourteen pounds during the last four months. He had been unable to work for some time on account of pain. Since the last operation three Röntgen-ray studies had been completed at different laboratories. He had been informed that the pictures showed nothing.

The patient was a thin, anemic, sickly looking man with an anxious expression. The general examination was essentially negative. The abdomen was not distended, the scar well healed. No organs were palpable. Splashing sounds were heard over the upper right abdomen and there was marked tenderness over the upper right rectus. The man was sent to the Lenox Hill Hospital for observation and study.

At the hospital his weight was found to be 118 pounds. Not much additional information was obtained by observing him. He complained much of pain and desired relief badly.

October 28, 1924 Operation: Excision of old epigastric scar. Dense adhesions of stomach, liver and small intestines to the anterior abdominal wall were found. They were difficult to separate and it was difficult to interpret the findings. Careful investigation showed that a Polya operation, ante colica, had apparently been done. An enormously distended loop of small intestines presented, which was found to be continuous with the pyloric end of the stomach. It was found that about ten inches below the pylorus there was a wide intestinal anastomosis, which apparently functioned all right, but this anastomosis and some of the gut below it had herniated into a pocket.

The stomach was not dilated, but its walls were hypertrophied. There were no adhesions except toward the pyloric end. There was no evidence of ulcer. A long loop of jejunum had been drawn up in front of the colon and used for a Polya operation, the afferent loop being attached to the lesser curvature and the efferent to the greater curvature. Instead of gastric contents emptying into the descending loop they emptied into the ascending loop and had brought about tremendous dilation and hypertrophy. The descending loop was collapsed and ribbon-like. It was possible however to invert the wall of either loop into the pylorus, the opening of the large end easily admitting a thumb, and that of the small end the tip of an index finger. Between the two there was a definite spur which no doubt produced difficulty.

Evidently this condition had developed soon after the resection operation, and the surgeon at that time had tried to overcome it by an anastomosis between the dilated afferent and the collapsed efferent loop. In this he had but partly succeeded. The hypertrophy and dilatation extended beyond the

anastomosis into both loops of gut, but chiefly into the afferent loop toward the fossa of Treitz.

As no ulcer was found the reason for the patient's present symptoms were considered to be the extensive adhesions and the herniation of gut which brought about an incomplete obstruction. The adhesions were therefore carefully separated and the gut then placed in a position as near normal as possible, pulling the transverse colon into position in such a way that half of it projected beyond the loop of small gut on either side. It was not believed that a gastro-enterostomy or another intestinal anastomosis could help the condition. The abdomen was carefully closed, bringing the peritoneal surfaces together separately by means of continuous chromic gut.

The wound healed by primary union and the patient was discharged, November 14, 1924; seventeen days after operation, almost completely relieved of his symptoms. However, the improvement did not last long. He was again seen May 27, 1925, when he complained of severe burning and cutting pain in the right side of the abdomen external to about the middle of the abdominal scar. He stated the pain was terrible and he was unable to work. There was no vomiting. His bowels moved daily without medicine. A tender swelling was noted at the site of the pain, but its nature could not be determined.

Medical treatment had no effect, but for fear of another operation he waited until July, 1925, when he stated that he suffered intensely and would rather die if he could not be relieved. Had been unable to work for a long time. He always referred his pain to one spot, just external to the umbilicus. A very tender, flattened, mass was palpable there which seemed to be attached to the abdominal wall. Operation was advised and performed July 16, 1925.

The old scar was excised. Intestines and liver were adherent to the anterior abdominal wall. While separating the small gut a hole was accidentally torn into it and repaired at once. A hard tumor mass was encountered adherent to the abdominal wall, at the place to which he had referred his pain. It felt like an ulcer or a carcinoma. In order not to tear into it the parietal peritoneum at the site of attachment was removed with the tumor. Examination then showed that they were dealing with the pyloric end of the stomach and its anastomosis with the jejunum, evidently a jejunal ulcer. With great difficulty the tissues were separated for identification and the condition was then found to be essentially the same as at the previous operation, except that the descending loop of gut was somewhat larger than before. A diagnosis of penetrating gastro-jejunal ulcer was made, and resection decided on with a posterior gastro-enterostomy by the Billroth II method:

The stomach was divided and turned downward over the colon. Proximal end closed. The two limbs of the gut were divided through the entero-enterostomy and the opening closed, giving thus a continuous gut. A posterior gastro-enterostomy was then done with the jejunum, proximal to the division, and suture just completed, so that a regular posterior short loop gastro-enterostomy had been produced. In removing the specimen it was found to be adherent posteriorly to a drawn up portion of the hepatic flexure, evidently the site of another penetrating ulcer. In separating them the colon was not opened, but a purse-string suture was taken for safety. The lower abdomen was found free from adhesions. The gall-bladder was normal.

The patient was quite shocked by the operation which lasted almost four hours. Hypodermoclysis had been given during the operation and under appropriate treatment he recovered satisfactorily.

The convalescence was uneventful, and he was discharged August 5, 1925; 20 days after operation, completely relieved of his symptoms. He has since

complained on and off of nausea, which is quite annoying, but he has had no pain. He is careful with his diet, but eats everything.

An X-ray examination made January 31, 1927, shows normal filling of the stomach with no deformity. The meal left the stomach very rapidly through the stoma of the gastro-enterostomy, so that at the end of three and one-half hours it had completely emptied. At the sixth hour the meal showed normal advancement into the large bowel.

Doctor Eggers expressed the opinion that this case apparently showed that it is not immaterial how a loop of intestine is attached to the stomach. In this case the loop had been so placed that the ascending portion was at the lesser curvature, and all or nearly all the food was emptied into this portion, producing an enormous dilatation with a vicious circle and requiring an entero-enterostomy for its relief.

GASTRO-JEJUNO-COLIC FISTULA

Dr. Carl Eggers presented a man, thirty-three years old, who was first seen by him, February 5, 1927. The chief complaint was diarrhœa, associated with loss of weight and strength. The man had to move his bowels ten to twelve times in twenty-four hours, chiefly during the day, but also two or three times during the night. Stool was always thin, never well formed, it was light in color and had a bad odor. No blood had been noted. Movements were not associated with pain or cramps. During the day he was able to control them quite well, but at night they would pass like gas, requiring constant use of a napkin. Since early childhood he had been subject to occasional upset stomach associated with acidity, which was always promptly relieved by a little alkali. As he got older, these attacks continued and were especially severe after drinking alcohol. A dilated ptosed stomach was diagnosed by means of the Röntgen-ray. It was negative for ulcer. With one of the attacks, about ten years ago, he had some hematemesis, and a surgeon was called into consultation who diagnosed ulcer and urged immediate operation. A gastro-enterostomy was performed the following day. He did quite well after that except that he still had his occasional stomach upsets until five years ago, at which time, without premonitory signs, and without any pain he suddenly developed diarrhœa, which in the beginning kept him up all night. There was no blood noted. In spite of treatment it continued, sometimes a little less, then again worse. He lost weight and strength rapidly. About six months after onset, while carrying a heavy case he suddenly became dizzy; he had slight pain in the region of his stomach, but it did not last long; there was an urge to move his bowels and when he reached the toilet he passed a large amount of blood, which shot out of his rectum. He was so weak that he remained in bed for a week, but there was no return of bleeding, and he had had none since. The diarrhœa however has continued until the present. In the course of the years he was seen by a number of physicians, various diagnoses were made, and various treatments instituted without relief. There were periods when he was hardly able to walk. Röntgen-ray examinations had been negative. Under rest treatment and rectal irrigations he finally gained a little weight. A recent X-ray examination gave the following findings:—

"The stomach is of about normal size, carrying a high situated anastomosis, which functioned well most of the time; occasionally a spasm would keep the anastomosis shut. The antrum formation was normal. The duodenum could be filled by manipulation, the bulb showed a definite deformity. During fluoroscopic examination it was noted that already about ten minutes after the ingestion of the barium there was some of it in the colon. To clear

up the situation a colon enema was done, which showed the sigmoid colon to be very redundant and wide, as well as the descending colon. At the splenic flexure the barium flow stopped for a short while, and when it continued, it had subdivided into two streams, running parallel for a while from left to right, and leading into the stomach and the transverse colon respectively. The enema was then stopped in the interest of the patient. The conclusion was that a gastrocolic fistula existed between the stomach and the splenic flexure."

On the basis of this he was referred to the reporter for operation. The man was a tall, anemic, thin man weighing 128 pounds. General examination was negative for organic disease. The abdomen was flat. There was no tenderness or rigidity and no mass was palpable. Rectal examination was negative.

Operation was postponed for personal reasons for a month. During the month the patient continued to lose weight and when admitted to the Lenox Hill Hospital, March 7, 1927, he weighed only 115¼ pounds. A transfusion of 500 c.c. of blood was given and operation was performed March 9, 1927.

Median epigastric incision. Stomach and omentum found extensively adherent to old scar, which adhesions had to be separated before the affected portion could be brought into view. The pyloric end of the stomach was completely buried in a mass of adhesions beneath the liver and could therefore not be visualized. The anterior surface of the stomach looked fairly normal. The stomach was of normal size. The lower border and posterior surface was adherent. The jejunum was about double its normal size and the walls were thickened. A wide communication existed with the transverse colon which passed just in front of the gastro-enterostomy and was closely adherent to the jejunum and the stomach. Whether a separate opening existed between the stomach and the jejunum or whether the whole thing was one large opening from the stomach into the small gut as well as into the colon could not be definitely made out. The colon proximal to the fistula was much larger than that distal to it. The peritoneum overlying the anastomosis was œdematous. In view of the uncertainty of the patency of the pylorus, it was decided to divide the colon on either side of the anastomosis, close all four ends and then unite the upper with the descending colon. This plan was carried out. Colon divided about one and one-half inches from the anastomosis on both sides. Ends closed by continuous silk and then buried by a purse string over which were placed interrupted sutures of silk. Good closure obtained. The midportion thus remained attached as a blind pocket to the jejunum and stomach. It was well supplied with blood and was about four inches long. The proximal colon as well as the splenic flexure were then mobilized sufficiently to bring them together by a lateral anastomosis without tension. Good opening obtained, easily admitting two fingers. Abdomen closed.

The patient recovered well from the operation, he had been given a hypodermoclysis during the operation and such administrations of water were continued. He passed gas during the first twenty-four hours. There was no vomiting. On the second day a little water was allowed per mouth, and the amounts increased from day to day. Bowels moved spontaneously a week after operation, and the stool was formed normally as it had not been for years. There were no symptoms in reference to the stomach, the portion of colon attached to it apparently had taken on gastric function and emptied promptly with the rest of the stomach.

A Röntgen examination made subsequent to operation showed the bismuth meal to leave the stomach by way of a deformed duodenum and also by

way of the gastro-enterostomy stoma. There was slight six-hour retention. A barium clysma showed a well functioning colon.

The patient was discharged from the hospital, April 6, 1927, about four weeks after operation. He had gained ten pounds during his stay. He has remained well since.

Dr. Albert E. Sellenings presented an X-ray and described a case in which, five years following a posterior gastro-enterostomy for pyloric obstruction, there appeared a sudden and persistent diarrhœa which later was accompanied by foul eructations. There was no pain and no abdominal cramps. Clinically the diagnosis appeared to be that of a jejuno-colic fistula. Subsequently the opaque enema demonstrated the communication. At operation dense adhesions were encountered, but in the final dissection there was found in the jejunum about one and one-half inches distal to the gastro-enterostomy stoma, an opening which communicated with the transverse colon. Examination of the stoma revealed no pathology. The openings in the jejunum and colon were closed with two rows of suture. It is now sixteen months since the operation and the patient is free of all symptoms and has gained forty pounds. He is observing a strict ulcer diet. The clinical diagnosis of jejuno-colic fistula should offer no special difficulty. As may be gathered from the literature, it would appear that the X-ray findings are not constant in revealing the condition. A gastro-jejuno-colic fistula may call for a rather extensive surgical procedure, but it is believed that in the jejuno-colic type, simple closure of the fistulous tract is the most justifiable.

FOUR YEARS AFTER RADICAL OPERATION FOR CARCINOMA OF THE FLOOR OF THE MOUTH

Dr. Carl Eggers presented a man who was admitted to the Lenox Hill Hospital, April 15, 1924, being then forty-two years of age. He complained of a swelling of the floor of the mouth which had gradually developed during the previous three months. A biopsy had been done by his family physician a week previously and a report of squamous-cell epithelioma had been made. The patient was a well nourished, healthy looking man whose general examination was negative.

Examination of the mouth showed the upper surface of the tongue to be clean. His teeth were in poor condition. On the floor of the mouth, just at the frenum, there was a hard, irregular, ulcerated mass which extended on both sides of the median line and on to the under surface of the tongue. The tongue was freely movable. The tissue immediately surrounding the ulcer was somewhat indurated. On the right side, a small granulating wound was noted, evidently the site of the biopsy. The submental lymph-nodes as well as the superficial cervical lymph-nodes on both sides were somewhat enlarged, but they did not feel unusually hard.

Radical removal of cervical lymph-nodes and bilateral block dissection was done, April 17, 1924, under colonic oil-ether anæsthesia. A transverse incision was made across the front of the neck at the level of the hyoid bone from one sternocleidomastoid muscle to the opposite one. A vertical incision was then added on either side extending from the ear lobe almost to the clavicle. A short median incision was made from the middle of the transverse one upward to the margin of the chin. The flaps thus outlined were dissected back leaving the platysma in contact with the lower ones by keeping it attached to the underlying tissue above. A block dissection of the neck was then carried out in great detail working on both sides at the same time, and removing the submental, submaxillary, superficial, and deep cervical lymph-nodes, down to the clavicle. The entire specimen was removed in one

piece. The skin was closed with interrupted silk and a split tube drain was inserted on either side through a stab wound behind the sternocleidomastoid muscle.

The patient made an uneventful recovery. The wounds healed kindly but there was a little fluid collection along the suture line from time to time so that the second operation could not be performed until eighteen days later, when the neck wounds had entirely healed.

Under colonic anæsthesia, May 5, 1924, the ulcerated area was lightly cauterized and then completely excised by means of Paquelin, keeping well beyond the margins of the tumor. In order to do that the remaining teeth had to be extracted and a part of the under surface of the tongue had to be taken away. An iodoform gauze tampon was packed into the wound and fastened to the outside by means of a silk thread. On the second day the gauze packing was removed without causing bleeding and the wound was thereafter kept clean by mouth washes. On the sixth day there was moderate bleeding from the wound due to separation of a slough. It was easily controlled by cauterizing with silver nitrate, and packing with an iodoform tampon. After that there was no untoward complication and the patient was discharged healed May 22, 1924, five weeks after his first operation.

The pathological examination showed no tumor involvement of any of the lymph-nodes removed from the neck. The microscopical examination of the mouth lesion showed the following: Sections of the tongue tumor show a squamous-celled epithelioma of typical structure. It is composed of columns and islands of squamous epithelium supported by a relatively small amount of compact cellular stroma. The epithelial columns show a tendency to break and often anastomose with one another. The epithelium is for the most part well differentiated and shows cornification and epithelial pearls. Mitotic figures are numerous. The tumor is very vascular and the stroma is richly infiltrated with inflammatory cells. The growth extends deep into the substance of the tongue though it does not perforate it. The tumor is surrounded by a rather wide margin of uninvolved tissue.

The patient has been seen frequently in the Follow Up Clinic and he has at no time showed any evidence of metastatic involvement. Although the tip of the tongue is missing and the tongue itself is rather fast, his speech is good and he has no difficulty whatsoever.

TYPHOID CHOLANGITIS AND CHOLECYSTITIS WITH MILIARY ABSCESSES OF THE LIVER

Dr. Harold E. Santee presented a woman, aged forty years, who had been in Bellevue Hospital repeatedly.

Her first admission was as Para IX to the medical service, from July 28 to August 7, 1923, with observations of fever, vomiting and a palpable spleen with an indefinite feeling of mass in the right upper quadrant of the abdomen. She was thought to have typhoid fever although Widal, urine, blood and Wassermann were negative. She was at full term and was delivered two days after admission. All the symptoms disappeared promptly after delivery.

April 7 to May 7, 1925, she was again in the hospital, five months pregnant, with complaints of fever, headache, diarrhœa, epigastric pain and vomiting. She showed rose spots and a palpable spleen. Her urine contained typhoid bacilli. Her blood showed white blood cells 3,500, polymorphonuclears 50 per cent. Blood culture was twice negative. Symptoms subsided and she went home.

July 16–August 7, 1925, she returned with a recurrence of symptoms and positive Widal. After the birth of her baby her symptoms gradually sub-

sided, although she was sick at home for some weeks after her discharge with weakness and swelling of the legs. She then remained well and had another baby, number eleven, in December, 1926. This baby died, although confinement and puerperium were normal. About three months later she began to have anorexia and diarrhœa of seven to eight movements a day. This was followed in three weeks by jaundice, gradually increasing, and its associated symptoms, and she was readmitted to the medical service, March 14, 1927. At this time she was showing jaundice of moderate degree with a liver edge palpable one inch below the costal margin and in the right upper quadrant under this edge could be palpated a firm, irregular, tender mass about the size of an egg. Temperature ranged about 100, pulse 92. The blood examination showed hæmoglobin 80 per cent.; red blood cells 4,800,000; white blood cells 6,800; polymorphonuclears 50 per cent. Blood pressure was 135 over 80.

Her condition gradually became worse. She was observed for six weeks before operation. Her temperature gradually became elevated to 103, then 104, with daily spikes averaging one and one-half degrees. Pulse remained relatively low. Spleen became palpable. Blood culture and stool culture three days after admission were negative for B. typhosus. Jaundice decreased at intervals only to increase again. After sixteen days, her icteric index was 84, Van den Berg reaction showed direct-delayed positive, indirect-positive. The Graham test at three weeks failed to visualize the gall-bladder. At four weeks the Widal was positive in all dilutions, the blood culture was negative, the blood examination showed hæmoglobin 70 per cent.; red blood cells 3,500,000; white blood cells 6,800; polymorphonuclears 50 per cent. Five weeks after admission and just after transfer to surgical service, the stool culture was reported positive for B. typhosus. At this time temperature was continuing about the same but clinically the jaundice was decreasing and was only slight at the time of operation.

Operation, April 25, 1927, revealed a dense mass of adhesions over the gall-bladder fossa, binding the liver, transverse colon, omentum and duodenum to the gall-bladder. Dissection was difficult but final exposure showed a very thick-walled, contracted gall-bladder containing two stones about 1.5 cm. in diameter. A little bile, of normal appearance, was present. The cystic duct was patent. The common duct was about 1 cm. in diameter but contained no stones on palpation. The liver itself showed on its anterior surface numerous small subserous abscesses. Puncture of two of these about the size of a pea showed thick, grayish, purulent material. Cultures from the stones and the bile showed B. typhosus. Culture from the abscess showed B. typhosus with some staphylococci—possibly contamination.

In view of the evident patency of the cystic duct, a tube was placed in the small, rather mutilated gall-bladder and the omentum brought over the gall-bladder. With a cigarette drain to Morrison's pouch the wound was closed.

Following operation the temperature subsided gradually and the patient improved progressively. Three days post-operative, the bile showed B. typhosus. Ten days later it showed colon bacilli. The tube was left in the gall-bladder for twenty-three days then removed. The sinus gradually decreased in size. Bile appeared in the stools in good quantity and culture of the stools was repeatedly negative for B. typhosus. Each time the gall-bladder fistula closed, however, a marked shoot of temperature to 103 or 104 resulted. For this reason, she was held in the hospital until August 14, 1927, when she was discharged home in good general condition but with a small gall-bladder fistula unclosed and intermittently draining large amounts of bile.

October 11, 1927, she was readmitted to the surgical service for her biliary fistula. Operation, October 21, 1927, was in the nature of an exploration to determine the cause of the sharp fever when the fistula closed and to institute proper measures for a cure. After injection of the sinus with peroxide and methylene blue, the tract was followed down to the gall-bladder region. The gall-bladder was thick and fibrotic and in the region of the ampulla lying in a small pocket contiguous to the common duct was a stone surrounded by a small amount of grumous material. The gall-bladder was removed and a probe could be passed directly from the region of the stone into the common duct and duodenum and upward apparently into the right hepatic duct. Due to the disturbed anatomy of the parts, however, it was impossible to say definitely whether this opening into the common duct represented the stump of the cystic duct or a perforation just below it. The hole in the common duct was lightly closed and the wound closed with drainage to Morrison's pouch and the bed of the gall-bladder. Cultures from the gall-bladder showed colon bacilli and staphylococci. Examination of the liver during the operation showed a thin, normal looking capsule with no evidence of the miliary abscesses present at the original operation.

Following operation by six hours, the patient vomited some of the methylene blue-stained mixture. She was in considerable shock and was transfused. Her general condition gradually improved but her local condition was discouraging as from the fourth day on, she began to discharge bile profusely from her wound. The stools became clay-colored and for five weeks, practically no bile showed grossly in the stools. Then she showed one light yellow stool and following this the stools intermittently showed bile. The sinus continued to show a profuse but slowly diminishing biliary discharge. December 9, 1927, she was discharged home with a biliary fistula and the feeling that when this fistulous tract had fibrosed sufficiently it might be necessary to transplant its superficial opening into the stomach or otherwise shortcircuit it. Much to the relief of the surgeon, however, she reported to him one month ago with this fistula completely closed and feeling well and happy.

MULTIPLE OPERATIONS FOR DUODENAL, MARGINAL AND JEJUNAL ULCERS

Doctor Santee presented a man who was forty-three years old when admitted to Bellevue Hospital, February 8, 1918, with a typical duodenal ulcer history of eight years' duration. Röntgenological examination showed an ulcer of the first portion of the duodenum. Operation, February 12, 1918, showed an indurated ulcer an inch in diameter, one inch beyond the pyloric vein on the anterior surface of the duodenum. This was folded in by a double purse string of chromic gut. A no loop posterior gastro-jejunostomy was then done by Doctor McQuillan using no clamps and absorbable sutures. An Ewald meal before operation showed a free acid of 68, total of 86. No test-meal was given after operation. Convalescence was satisfactory and he was discharged, March 8, 1918. A follow-up note three years later, in February, 1921, states he had no gastric symptoms but was constipated.

March 10, 1926, he was readmitted with a history of eight months of "distress" in the stomach, relieved by vomiting and less marked when bowels moved regularly. An Ewald meal brought nothing back after one hour. Operation, March 16, 1926, revealed a chronic perforating marginal ulcer with a deep sacular crater jutting out into the right leaf of the mesocolon

about the stoma. This was palpated through an anterior gastrotomy opening, as was the pylorus and first portion of duodenum. No evidence of old duodenal ulcer except a slightly thickened scarred area was made out. It was thought to be healed. The gastro-enterostomy was undone by the reporter and the stomach, jejunum and mesocolon closed to approximate the normal as nearly as possible after the marginal ulcer had been excised. The patient was discharged, April 11, 1926. Just before discharge he showed in the Ewald meal a free acid of 65, total 80. He also complained of some "burning" after eating.

September 9, 1926, he was readmitted, complaining mostly of hemorrhoids but also of considerable gastric distress after meals, more marked for the past two months. He was on a medical régime for one month and then transferred to the surgical service. His hemorrhoids were remedied under spinal anæsthesia. September 22, 1926, or six months after his previous gastric operation, an X-ray examination showed an ulcer of the first portion of the duodenum with a small six hour retention. October 15, a serial stomach test showed free HCl as follows: half hour 40; hour 74; hour and one-half 89. Five days later, another test-meal showed as follows: 55 minutes, free HCl 60; total 75; 80 minutes, free HCl 75, total 90; 110 minutes, free HCl, 45, total 80.

Operation, October 29, 1926, revealed a small duodenal ulcer on the superior aspect of the duodenum, just distal to the pylorus with adhesions of duodenum to the liver. A subtotal resection of the stomach from just proximal to the pyloric ring back through the pars media was then done and a posterior gastro-jejunal anastomosis made after suturing down from the lesser curvature about 3 cm. After this operation the patient did very well and went to the Burke Foundation in good general condition, December 10, 1926. He did not return to the Follow Up Clinic.

In December, 1927, Doctor Santee was invited to be present at a final operation upon this patient by Dr. A. A. Berg at Mt. Sinai Hospital. Through the courtesy of Doctor Berg he was able to report the following findings: In a subtotal resection and Finsterer anastomosis, the stoma was normal. About one and one-half inches distal to the stoma in the efferent loop of dilated jejunum was an ulcer the size of a quarter dollar. The transverse colon was attached to this through a mass of adhesions and a small jejuno-colic fistula was present. The colic fistula was closed and a larger resection including anastomosis and jejunal ulcer was performed. Repair was effected by end-to-end anastomosis of the jejunum and anastomosis to the open end of the stomach.

Dr. Richard Lewisohn stated that this case had interested the surgeons at Mt. Sinai Hospital very much, because they had believed with Doctor Santee that he had performed a subtotal gastrectomy. But when Doctor Santee looked up the records, he found that he had done a Finsterer operation. Haberer has demonstrated that recurrences following the Finsterer operation are not infrequent. Doctor Lewisohn stressed the importance of care in nomenclature in reporting these cases; the only operation that could properly be called subtotal gastrectomy was a surgical procedure which removed about two-thirds of the stomach with the pylorus and the diseased part of the duodenum.

A STUDY OF 520 CASES OF FRACTURES OF THE SKULL

Dr. John A. McCreery read a paper with the above title, written by himself and Dr. Frank B. Berry, for which see page 890.

Dr. Alfred S. Taylor considered the problem of fractured skulls as essentially one of brain injury, with bone injury entirely incidental. Symptomatology is important chiefly as a guide to treatment. Choosing the correct treatment is often difficult. The cases may be grouped according to type and degree of brain injury; the important corresponding symptoms would follow, after which the principles of treatment could be discussed.

Degree of Brain Injury.—Group 1.—Intra-cranial, extra-cerebral lesions:

(a) Epidural hæmorrhage (usually from middle meningeal).

(b) Subdural fluid accumulations, (Naffziger) (cerebro-spinal fluid; clear or blood stained.)

(c) Hæmorrhage from the tentorial venous sinuses, causing basal clot, slowly expanding (often occur without bone injury).

The primary injury may cause loss of consciousness varying in degree and duration but brain injury proper is absent and the essential symptoms are due to compression of the brain, the signs of which develop *pari passu* with increase in the collection of fluid, which may be rapid or slow in the individual case.

The epidural clot and subdural fluid sub-groups usually lie over the convexity of the hemispheres. They cause signs of increased intra-cranial pressure, plus, as a rule, pressure on the motor cortex, causing first irritative (convulsive) and then later paretic phenomena.

The tentorial sub-group causes pressure on the mid-brain and bases of the hemispheres at first, and then, by extension of the clot up on the convexity, may cause symptoms similar to the other two sub-groups. However, these symptoms may not appear for days or weeks after the primary injury, and then develop slowly.

In neither the epidural hæmorrhage nor in the subdural fluid sub-group is there direct communication with the subarachnoid space.

In the tentorial sinus sub-group the hæmorrhage is intrinsically subdural and becomes subarachnoid only if the arachnoid happens also to be torn at the time of injury.

Group 2 includes the cases involving intrinsic damage to the brain substance; contusion and laceration varying in degree and distribution, and therefore causing the very variable symptoms so well-enumerated in the paper. Gross hæmorrhage with localized pressure is not common so that localizing symptoms are less evident. It is in this group that brain damage by contrecoup is frequent.

In many cases the pathology of groups one and two may both be present with corresponding confusion of symptomatology. In both groups, œdema of the brain soon develops causing increased intracranial pressure, far greater as a rule in group two, (because of intrinsic brain damage) than in group one.

Symptomatology.—Group 1 shows more or less primary loss of consciousness, followed by lucidity, and this again by signs of increasing intra-cranial pressure, indicated by motor cortex irritability or paralysis, and deepening coma.

Group 2 shows primary loss of consciousness, which is usually more marked and of longer duration than in group one.

Focal paralytic symptoms are not so common but there is more disturbance of the mid-brain and stem, as indicated by the marked circulatory, respiratory and pupillary changes. In the severe cases, coma rapidly deepens and death ensues in a few hours. In more fortunate cases lucidity gradually reappears and recovery occurs.

Spinal Fluid Tap.—Clear in Group 1, sub-group (a).

Clear or blood stained in Group 1, sub-group (b and c).

Bloody in practically all cases in Group 2.

Pressure increases *pari passu* with increased intra-cranial pressure.

Pupillary Signs.—Fixation of one or both pupils means serious injury of the mid-brain. Fixation plus wide dilation of one or both pupils indicates such serious injury that death is practically sure.

Fundi.—Even in the face of marked increase of intra-cranial pressure as indicated by the spinal manometer, there is usually no evidence of choked disc for at least forty-eight hours, so that fundus examination is not helpful in the very early cases, unless possibly engorgement of the veins might be suggestive. Respiration is likely to be stertorous, but if it develops the Cheyne-Stokes syndrome the outlook is unfavorable.

The *pulse* is usually slower than normal. The pressure may gradually increase but has no fixed ratio to the intra-cranial pressure. If the pulse, after a period of retardation, climbs to 100 or more, and especially if there is associated Cheyne-Stokes respiration, it means that the medullary centres are exhausted and death is imminent.

Treatment.—Group 1.—Sub-group (a) Operation when the diagnosis is made.

Sub-group (b) Operation when the diagnosis is made.

Sub-group (c) The symptoms appear late, the clot surrounds the mid-brain, is extensive and there is little prospect of a favorable result from operation, which however might be tried.

Group 2.—There has been much argument concerning decompressive operations in this group. It is asserted that death has been prevented, and more particularly that post-traumatic sequelæ; headache, vertigo, tinnitis, neurasthenia, etc., are not nearly so frequent. However, the majority of men, dealing frequently with these cases, operate rarely, using instead means devised to give similar relief without operation.

Spinal Tap.—This gaves great relief to pressure and furnishes valuable information.

It may and should be repeated frequently enough to relieve the intra-

cranial pressure. There is no menace to the medulla such as exists in posterior fossa tumors.

Hypertonic Solutions Intravenously.—Salt, and magnesium sulphate, have been almost entirely replaced by glucose solution, 25 per cent. or even 50 per cent. in doses up to 250 c.c. It must be sterile and made with perfectly freshly distilled water. It may be repeated. Fluids in general should be limited, or withheld. Caffein-sodium-benzoate intravenously causes definite and fairly lasting diminution in intra-cranial pressure.

Confinement to bed for at least three and preferably six weeks will eliminate many of the subjective sequelæ.

In cases of persistent headache the lumbar air injection advocated by Penfield should be tried. One other observation made by Penfield in his experimental animals may compel revision of our attitude toward operation in these cases. His observation is that brain, damaged by needle puncture, or by laceration, if left in situ, causes marked adhesions to the dura, which may cause distortion of anatomical relations, or irritation leading to convulsive sequelæ; whereas if the damaged brain material is removed, the above sequelæ do not occur.

It may therefore eventually be indicated to operate in cases, especially where motor or nearby cortex is involved, to remove the damaged material to prevent Jacksonian epilepsy from developing.

Dr. John C. A. Gerster remarked that it would be important to know what percentage of the patients who survived have been able to resume their work. It was a fact that after apparent recovery for a year or two such patients not infrequently underwent change of mentality and disposition and that a large percentage of them did not live more than five or six years.

Dr. Fenwick Beekman stated that the conclusions of the author fitted in well with those of his own study on cases of Head Injuries in Children which he had reported recently. One of the differences found between fractured skulls in children and in adults is that in the former fracture of the vault so often occurs without brain injury. Hæmatomas under the scalp overlying the fracture of the vault are found commonly in children, while in adults they are not so frequently present. These hæmatomas are often due to blood seeping out from the skull thereby compressing the brain. In the treatment of fracture of the skull with laceration of the brain, Doctor Beekman was in accord with Doctor McCreery, in that decompression does not give decided relief, but spinal puncture does; only to be used, however, when indicated. In his series of 331 cases of Head Injury in Children there were thirty-eight deaths, seven died from meningitis; of the remaining thirty-one cases twenty-eight died in the first forty-eight hours, all showing signs of laceration to the brain. The highest mortality occurred, therefore, the same as in adults within the first twenty-four hours following the accident. Sequelæ were apparently less often found in children than in adults. At the end of two years only five per cent. of his cases with fractured skull suffered from sequelæ. The sequelæ were not often of organic lesions, but those of

emotional upset. There was a large number whose behaviorism had changed completely. Often they were amenable to training and after two years the symptoms frequently disappeared, although there were two or three who had to be sent to reformatory institutions as they could not be looked after at home. After changes in behaviorism, the commonest sequelæ was headache; this cleared up, however, in all but two cases. One had had a compound fracture which was not decompressed.

Dr. Frank B. Berry (by invitation) said that the intravenous use of caffein, suggested by Doctor Taylor, had not been tried in this series. He was in agreement with Doctor Taylor as to the fundus changes but there had been a small group of cases in which after several days choked disc persisted, and the patient was operated on for this reason. There are many difficulties in obtaining follow-up statistics at Bellevue Hospital. As Doctor McCreery mentioned, 50 per cent. of the cases have expressed themselves as being perfectly well. The longest follow-up was three to four years but there were very few of these. The speaker did not believe that any of the cases in this series had had repeated lumbar puncture.

Doctor McCreery in closing the discussion said that the occasional cases of low spinal fluid pressure had been interesting, but unfortunately they had not been accurately measured. In none of them, however, had there been any noticeable amount of bleeding or cerebro-spinal discharge from the ears or nose. In one recent case there had been an initial pressure of 2 mm. This was in a patient with a considerable degree of concussion and the pressure in the course of four or five hours had gone up to 10 mm. It might be that the low pressure was a temporary phase in the early stages of severe concussion.

The possibility of recurring hæmorrhage as a result of sudden lowering of pressure by tapping in the early hours must be considered, but he felt that this was not likely to occur if the fluid was removed slowly and the pressure lowered by gradual stages. In this series they had not felt that bleeding had been increased by careful tapping. Adding to body fluids while there was increased spinal pressure made more difficult the lowering of the latter, but in the occasional case of shock the latter condition had seemed the more urgent and those cases had been treated by the usual anti-shock methods. While marked fundus changes might only appear after forty-eight hours he still felt that considerable early information might be obtained by more regular and frequent examination of the eye grounds.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING HELD APRIL 2, 1928

The President, Dr. Astley P. C. Ashhurst, in the Chair

Calvin M. Smyth, Jr., M.D., Recorder

FRACTURE OF HUMERUS COMPLICATED BY INJURY TO MUSCULO-SPIRAL NERVE

Dr. James A. Kelly presented a man aged nineteen, who was admitted to St. Joseph's Hospital, November 30, 1926, suffering from a fracture of the left humerus about the junction of the lower and middle thirds; laceration of the left axilla, extending from the anterior axillary fold through the axilla to the posterior axillary fold, exposing contents of the axilla and particularly the axillary artery and vein. The two latter were completely separated from their surrounding fatty coverings. There was no injury to either vessel. In addition there were several lacerations about the head and face. Under anæsthesia the lacerations of the head and face were thoroughly cleansed and sutured. The axillary wound was sutured. The fracture of the left humerus was reduced and dressed. The patient made an uneventful convalescence from his wounds.

January 3, 1927, he was readmitted on account of musculo-spiral paralysis. Examination on readmission showed the left upper extremity held with the forearm flexed at right angles to the arm. The wrist flexed so that the hand hung at a right angle to the forearm. He was unable to extend the wrist or to supinate the hand. Pressure over the site of the fracture of the humerus caused burning sensation on the dorsum of the thumb and the radial side of the hand. Biceps, triceps and extensor tendons—at wrist—reflexes were absent. There was an area of anæsthesia over the lateral and posterior aspects of the arm. This area extended from the shoulder cap almost to the elbow. No areas of anæsthesia were found in the forearm; over the lateral aspect of the index finger there was an area of anæsthesia which extended about one inch proximal to the metacarpo-phalangeal articulation. He was unable to extend the hand or fingers, and there was very little movement at the elbow.

Neurological examination, January 7, 1927, revealed a typical wrist drop which, with the other findings present, indicated that there had been damage to the median, musculo-spiral and the ulnar nerves.

At operation, January 12, 1927, exposure of the two ends of the lacerated musculo-spiral nerve showed a separation of about one and one-half inches. These ends were bulbous in character. There was solid union at the site of fracture. The two ends of the musculo-spiral nerve were drawn together, the bulbous portion of the ends excised, and the ends of the nerve held together without tension by means of four fine silk mattress sutures. A square flap of fat and fascia was then dissected on three sides from the superficial fat and fascia, and placed about the line of sutures on the nerve, acting as a cuff. The wound was closed without drainage. Primary healing took place and the patient was discharged, January 25, 1927. At present the patient is able to play base-ball, basket-ball and other sports.

An examination made March 12, 1928, showed complete function in this

limb with one slight exception, and that is failure to fully extend the thumb. The extensor muscles are not yet as strong as those on the opposite side but they have considerable power. There is no appreciable atrophy of any muscles

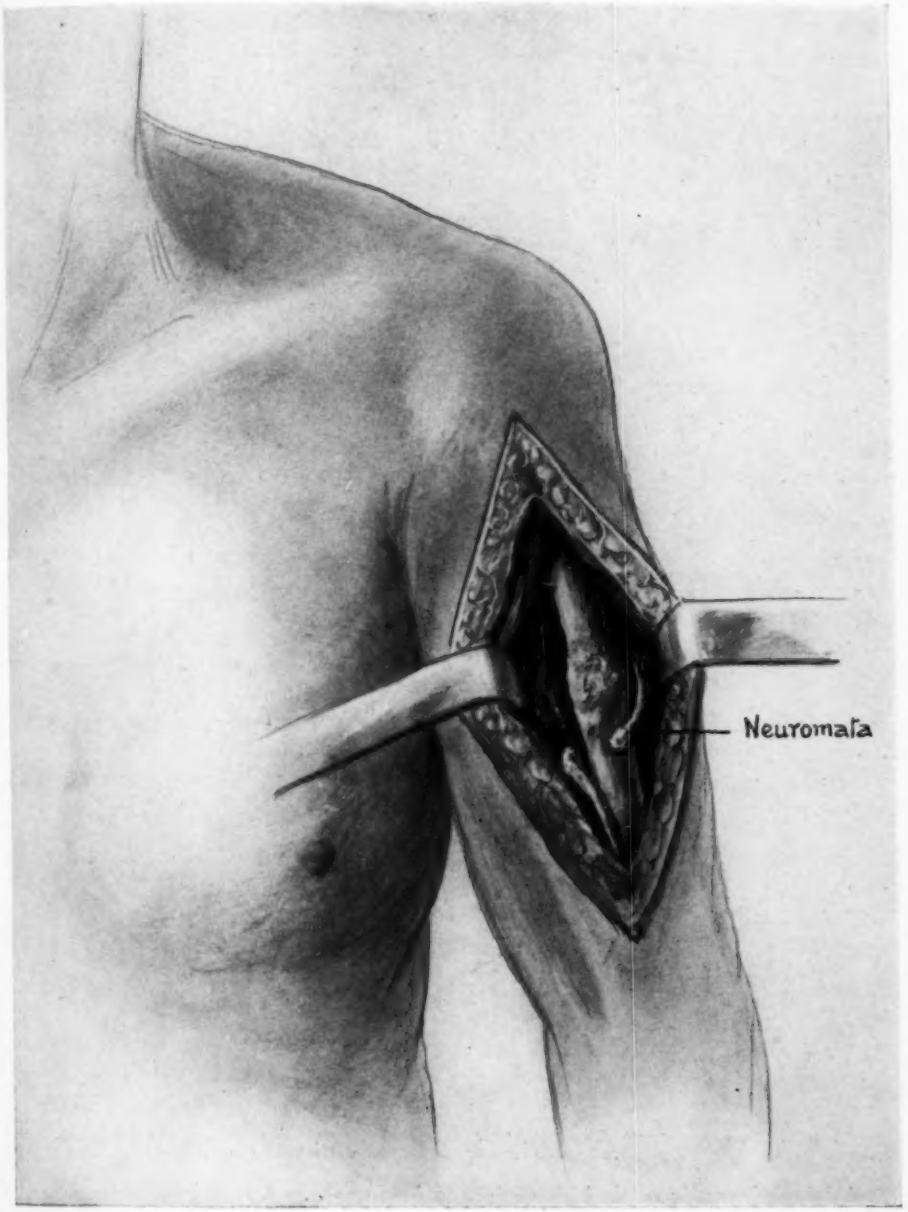

FIG. 1.—Condition found at time of operation six weeks after injury, and cut ends of musculo-spiral nerve separated about 1½ inches, with bulbous ends.

supplied by the musculo-spiral nerve. The left deltoid muscle is completely atrophied but the suraspinatus has taken over its function, so that the patient is able to extend the limb at right angles to the trunk and about the head. The

biceps and triceps reflexes are normal. The electrical reactions are as follows: To galvanism in the musculo-spiral distribution the CCC. is greater than the ACC., and the size of the contraction is almost normal. There is still

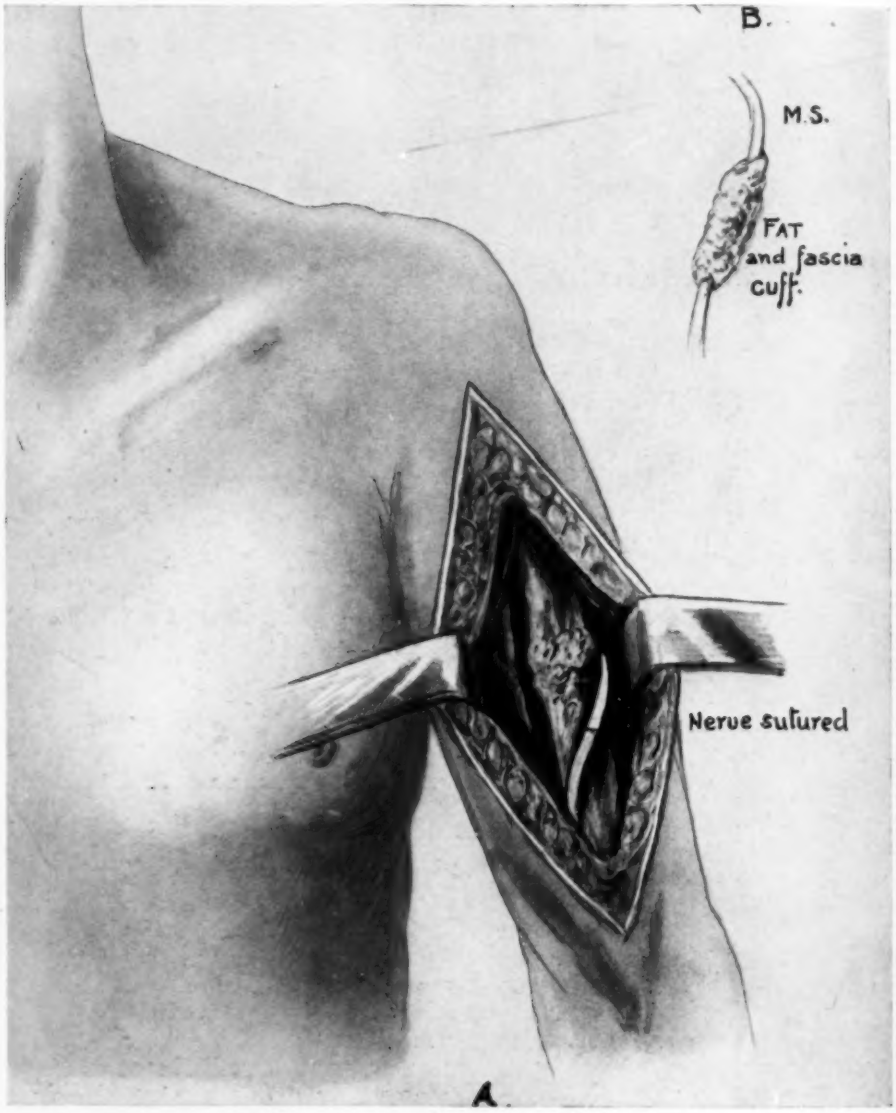

Fig. 2.—A. Shows nerve dissected from callous; bulbous ends resected and nerve sutured. B. Sutured nerve surrounded by cuff of fat and fascia.

diminished farradic excitability. There is no response to either current over the deltoid.

There is an area of anæsthesia for light touch and pin-prick over the lower two-thirds of the deltoid and the upper two-thirds of the triceps. Deep pressure over the musculo-spiral distribution anywhere causes pain. The area of anæsthesia over the deltoid corresponds very well to the distribution of the circumflex nerve. The area over the triceps, however, covers the distribution for

several nerves, namely: Part of the area supplied by the external cutaneous and most of that supplied by the internal cutaneous and perhaps that part supplied by the intercosto-humeral.

The patient thinks that he began to have return of function eight or nine months after the nerve was sutured. Doctor McIver who made the examination stated that he had never seen a case of deltoid-paralysis in which the supraspinatus took on its function.

CARCINOMA OF THE JEJUNUM

DR. J. JAMES CANCELMO, by invitation, reported the case of a woman, aged sixty-three, who was admitted to St. Mary's Hospital in the service of Dr. James A. Kelly, June 21, 1927, complaining of "indigestion" of eight years

FIG. 3.—The glass rod about 3 mm. in diameter extends into the annular constriction due to carcinoma. To the left the enormously distended bowel may be seen. The portion of gut lying immediately above is the tissue from which the sections (4 and 5) are taken.

duration; for the past four years her symptoms have been getting worse. Eight months ago she noticed some enlargement of the abdomen which had slowly been increasing. Her appetite was poor and about one hour after each meal she had cramp-like pains in the middle of the abdomen. She had always

been costive and took purgatives daily. Vomiting occurred almost daily. The past history is negative except for childhood diseases. Examination revealed a distended abdomen with visible peristaltic waves in the lower part of the upper right quadrant. No tenderness; no masses palpable. The usual examinations of the blood and urine were negative; the blood chemistry and tests of kidney function were within normal limits.

Fluoroscopic examination of the gastro-intestinal tract showed that the duodenal cap filled after considerable difficulty, and exhibited a flattening not only of the cap but of the entire pyloric end of the stomach. The head of the six-hour meal remained in the small intestine which was tremendously dilated, and showed very active peristalsis. Evidence of obstruction was present in the small intestine at a considerable distance from the pylorus, but the exact nature could not be determined.

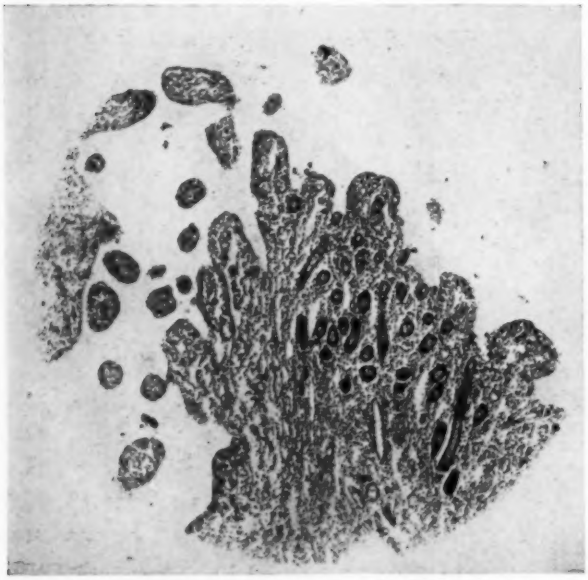

FIG. 4.—Sixteen mm. objective. Normal jejunum. Cross and tangent section of villi and crypts of Lieberkuhn.

At operation, by Dr. James A. Kelly, June 27, 1927, a large mass was exposed, involving about three feet of jejunum. The gut was grayish in color and was held together by adhesions. In the middle of the mass infiltration was marked. Above the indurated area the gut was greatly distended, and below it was collapsed. There were very few enlarged nodes, except in the immediate vicinity of the growth. A section of the gut, measuring four feet, was removed with its mesentery. An attempt to restore the continuity of the bowel by end-to-end anastomosis was unsuccessful, due to encroachment upon the lumen. The anastomosis was therefore made by a simple lateral short circuiting operation. The abdomen was closed without drainage. The patient was discharged on the eighteenth day after operation, very much improved.

Pathological Report.—Macroscopic: The operative removal is a large mass of adherent loops of jejunum which when separated measure 117.5 cm. in length. A small firm tumor was present in the centre which when cut out measured 3.7 cm. x 2.5 cm. x 1.2 cm. and was found to be an annular or ring neoplasm, encircling the intestine and constricting the lumen which admitted a 5 mm. quill. The intestine on the proximal side was dilated times two. There were several small polypoid growths of brittle tumor mass extending into the dilated intestine of the proximal side. The neoplasm had invaded all the coats of the intestine but none of the other loops were involved. (Fig. 3.)

Microscopic: Study of the neoplasm reveals a primary adeno-carcinoma in the mucosa of the jejunum which invades the muscular and serous coats. The tendency to form acini with central lumen is lost as the tumor cells penetrate the mucosa and they diffusely infiltrate the muscle in the form of small alveoli consisting of compact masses of cell groups. (Figs. 4 and 5.)

Pathological Diagnosis: Primary adeno-carcinoma of the jejunum.

The reporter added that Probstein [1] states that in 41,858 necropsies performed at the Vienna General Hospital, 3,585 were carcinoma, of these 342 were in the intestinal tract and only nine of these were in the jejunum. In the past twenty years, 4,684 cases of gastro-intestinal carcinoma have been operated on at the Mayo Clinic, and thirty-six cases or less than 1 per cent. were in the small intestines.[2] Unless the carcinoma is obstructive the physical findings show very little that enables one to make a diagnosis. The mass is very often not palpated because of the fluidity of the intestinal contents. Auscultation should help more but there is little evidence that his procedure is much used. Unless the lesion is ulcerative blood is not found in the stools so that this test does not help much. Even the X-ray seldom points out the lesion to be carcinoma.

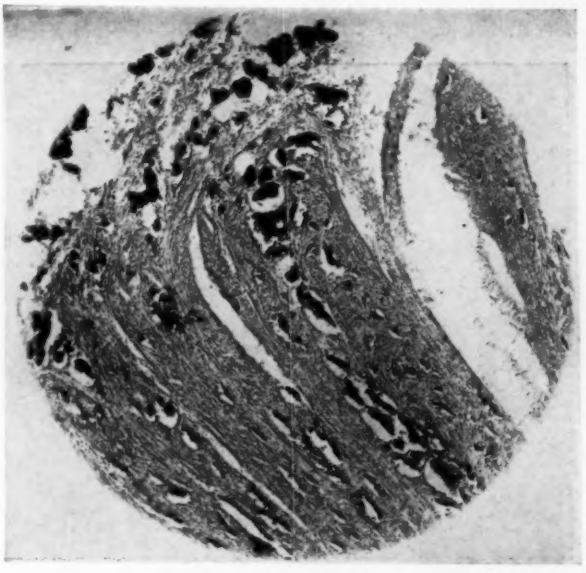

FIG. 5.—Sixteen mm. objective. Primary adeno-carcinoma of jejunum. The tendency to form acini is lost as the tumor cells penetrate the mucosa and they diffusely infiltrate the muscle in the form of alveoli.

BRICKNER and MILCH [2] report a case of carcinoma of the ileum in which the symptoms were those of sciatica. Nuzum [3] has observed two instances in which the patient's conditions were diagnosed as pellagra and at autopsy, carcinoma of the terminal portion of the ileum was found. Rankin [4] reports four cases of acute intestinal obstruction due to malignancy, while Morrison [1] reports a case of high intestinal obstruction due to carcinoma.

Prognosis: The cases of intestinal carcinoma which have the best outlook are those which are operated upon earliest. Those with obstructive lesions will be seen earlier than others. One is impressed with the fact that the lower the lesion the better the prognosis. In the reporter's case, the lesion was an annular carcinoma. Its removal was not only feasible, but indicated. At the present writing three months after operation, the patient has gained thirty pounds in weight, has regained her strength and has no complaints.

DR. DONALD GEIST reported from the service of Dr. James A. Kelly, at

[1] Probstein, J. G.: Subacute Ileocolic Intussusception Secondary to Carcinoma of the Ileum. Surgery, Gynecology and Obstetrics, vol. xlii, pp. 769–771, June, 1926. Quoted by Morrison. High Intestinal Obstruction Caused by Primary Carcinoma of the Proximal Jejunum. The American Journal of Surgery, vol. ii, pp. 154–159, February, 1927.

[2] Brickner, Walter M., and Milch, Henry: Carcinoma of the Terminal Ileum Causing "Sciatica". International Clinics, vol. iv, pp. 238–239, December, 1926.

[3] Nuzum, Franklin R.: Pellagra Associated with Annular Carcinoma of the Terminal Portion of the Ileum. Jour. A. M. A., vol. lxxv, pp. 1861–1863, December 12, 1925.

[4] Rankin, Fred W.: Acute Intestinal Obstruction Due to Malignancy, vol. xlii, pp. 638–643. Surgery, Gynecology and Obstetrics, May, 1926.

the Misericordia Hospital, the case of a white woman, age forty-three, who was admitted to hospital, October 9, 1927. Her chief complaint was bloody stools. She stated that two years prior to admission she began to have aching abdominal pain about the umbilicus, radiating from right to left abdomen. Occasionally she noticed small amounts of bright red blood mixed in with the feces. Pain gradually grew worse and in January, 1927, became very severe and was associated with marked diarrhœa and loose, watery stools containing large amounts of bright red blood. This attack lasted for about two months and then subsided, the pain ceasing first and then the blood, the stools very quickly becoming formed. She remained well until the latter part of June and early July when she had a second attack, exactly similar and lasting five weeks. From the end of this attack to the date of admission she remained well and free of symptoms. Appetite good and no loss of weight noticed. Only other symptoms were occasional swelling of the feet and ankles, and occasional frequency of urination. Past medical and social history were negative. Family history showed the presence of malignancy in one sister, one brother and father and grandfather but was otherwise negative.

FIG. 6.—Polyposis of colon; gross appearance. A portion of the section removed.

When admitted no definite mass was palpable although there was a suggestion of a soft mass just above and to the right of the umbilicus, suggesting a mass in the transverse colon. Rectal examination was negative. Blood Wassermann was negative in both the acetone insoluble antigen and the cholesterin antigen. Feces were positive for occult blood.

X-Ray examination of the colon showed an "irregular filling defect in the first part of the transverse colon. This was suggestive of multiple polyposis, possibly associated with ulceration."

Operative Findings.—The patient was operated upon by Doctor Kelly, October 15, 1927. Upper right rectus incision. Most of the transverse colon lay below the umbilicus. Its appearance was normal. Palpation revealed numerous, small, soft, pulpy, grape-like masses, apparently springing from the mucosa and slipping from the grasp quickly and easily. The outer coats of the bowel were smooth, pliable and showed no evidence of induration or fixation. There were no adhesions and no masses felt in the mesentery or omentum. The growths began about 100 cm. from the splenic flexure and extended for about 25 cm. to the left. About 25 cm. of the transverse colon were excised with the cautery. An end-to-end anastomosis was done. There resulted good approximation with an opening of over two fingers' breadth diameter. The abdomen was closed without drainage. Diagnosis at operation was diffuse polyposis of the transverse colon.

Progress of Case.—Except for occasional vomiting of small amounts of bile-stained fluid and hiccoughs which stopped on the second day after gastric

lavage, convalescence was uneventful until October 26, when she developed slight tenderness in the right calf and inner thigh, a definite but mild phlebitis. This subsided and on November 4, 1927, she again was well. The first bowel movement occurred on the fourth day after operation and recurred daily for five days. They showed no gross blood. Three examinations of the feces were negative for occult blood. Barium enema the day before her discharge resulted in the report, "Injection of the colon shows an extremely short, ascending colon, measuring 10 cm. There is a very marked incompetency of the ileocæcal valve. At the site of the operation there is a very slight constriction. The remainder of the colon fills normally." The patient was discharged in good condition on November 13, 1927.

The pathological report recorded that the portion of the colon removed was covered with upwards of 300 pedunculated tumors ranging in diameter from three to four millimetres to about one centimetre, round, of a dark red color, a few of the largest showing bleeding points corresponding to superficial ulceration (Fig. 6.). Some of the smaller tumors have no pedicle. The tumors are soft, the base does not appear to infiltrate the mucosa and no evidence of tumor is seen anywhere else in the deeper structures of the colon. Lymph-nodes of the mesentery are not enlarged. Microscopically (Figs. 7 and 8), the polyps are formed of a well developed vascular pedicle, supporting a papilliferous growth formed of connective tissue frame-work with well-formed lymph-nodes. They are covered with cylindrical epithelium often showing mucoid degeneration. Mucus glands are well developed and the epithelium occurs everywhere in a single layer, the cellular elements being normal."

The reporter added that the presence of polypi in the gastro-intestinal tract has frequently been reported.

Statistics as to incidence are varied and scattered and difficulty is experienced in arriving at the true frequency of the lesion.

Two theories as to the origin of polyposis have gained prominence although many factors have been projected as causes. The first of these is that the lesion is congenital in origin. The second theory is that the lesion is an acquired one and the result of chronic irritation and inflammation. Among the many forms of irritation mentioned are chronic gastritis, atrophic gastritis, constipation, dietetic errors, irritation by foreign bodies or parasites such as the ascaris, alcoholism, faulty and incomplete mastication and atheroma of blood-vessels. There may be a certain hereditary influence in cases of gastro-intestinal polyposis, as the lesion has been found in brothers and sisters, twins and in mother and son. Certain observers state, "It is very probable that there are two types of epithelial overgrowth, an hyperplasia secondary to inflammation and an hypertrophy congenital in origin."

A variety of pathological entities have been included in the term polyposis. Polypi are fairly commonly seen in the rectum and there are numerous cases of multiple polypi scattered through the gastro-intestinal system. Myomata, fibromata, adenomata and carcinomatous growths, which assume a polypoid form, are included. Menetrier's pathological classification is still accepted. He divides polyposis into two groups: the first, polyadenoma polypeaux, in which a great many separate and discrete, usually pedunculated or lobulated

nodules involve the mucosa; the second group he calls polyadenoma en nappe, in which, there is a raised, plaque-like, non-lobulated, non-pedunculated layer of hypertrophied mucous membrane. The individual polypi appears as soft, warty growths, varying in size from that of a pea to that of a nut or even larger. The color varies from a gray to a red or reddish-brown and the polypi often exude a considerable amount of mucus. They are lobulated or pedunculated and scattered diffusely but closely together along the mucosa. The number varies from a few to several hundred or more. Often they show small hæmorrhages or ulcerations. Frequent inflammatory changes occur. Microscopic examination shows the normal epithelium of that portion of the gut in which they occur and a supporting stalk of connective tissue. The submucosa is well developed and normal and often the muscularis mucosa is well seen. Malignant degeneration frequently occurs and shows itself by the same changes as in other neoplastic growths, namely: undifferentiation of the epithelium, pleomorphism, mitosis and the extension of the epithelium past its normal boundaries. The actual frequency of such changes varies from 12 per cent. or 17 per cent. to 60 per cent. according to different authors. The other common secondary change is inflammation, the result of frequent irritation and trauma.

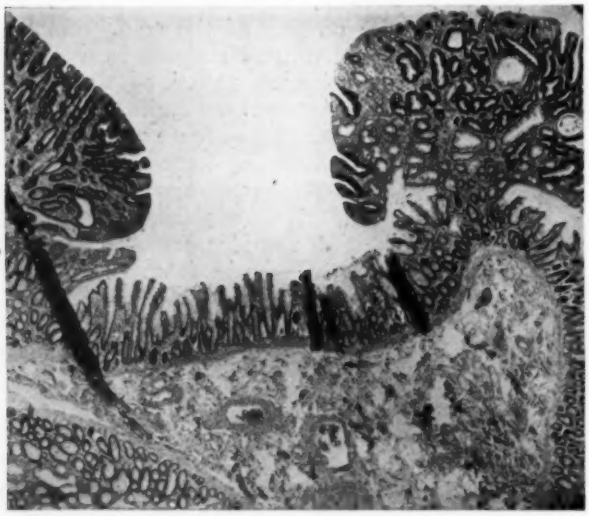

FIG. 7.—Section of polyps of the colon (microscopical).

Polyposis offers no definite symptom complex. The disease may produce the most variable of symptoms or be marked in its involvement and yet devoid of signs. When the stomach is involved the symptoms are often those of any gastric disorder, be it ulcer, carcinoma or gastritis. They are, however, usually of long duration and with little or no constitutional effects. Abdominal pain and distress are frequent. The pain has no reference to meals, time of day, or type of food and may be mild or severe. However, frequent eating of small amounts of food often gives relief. It occurs no matter whether the lesion be in the stomach, small or large intestine. Vomiting, anorexia, constipation and weakness are noted. Hæmatemesis occurs and there is often occult blood in the stools but the acute hæmorrhage is rarely fatal. The picture may be that of a long-standing anemia with its blood findings, a little shortness of breath, pitting œdema of the extremities and weakness. A fairly constant finding, and one reported by many, is the presence of a marked diminution in or absence of

acid in the gastric contents. Due to the latter, diarrhœa may develop. When the growth involves the colon there is marked diarrhœa, tenesmus, hæmorrhage from the bowel and often pus and mucus in the stools. Yet with it all, loss of weight is slight and the general appearance of the patient is that of good health. The blood picture is negative or shows a moderate secondary anemia. Physical examination is usually negative although in some cases a mass may be felt. The latter is soft, freely movable and slips from the grasp easily so that a second effort at palpation makes one believe that there is none. Occasionally the symptoms become those of obstruction or intussusception and the latter is frequent in its occurrence.

FIG. 8.—Section of polyps of the colon (microscopical).

The X-ray findings are significant and the diagnosis often made by this means alone. According to the late Doctor Carman, "The röntgenograms show a diffuse mottled appearance of the pars pylorica and the lower pars media without six-hour retention or a correspondingly palpable mass. This mottling is due to the displacement of the barium by the approximation of the polyps which, offering no resistance to X-ray, produce numerous small, black shadows in the silhouette of the stomach." The same mottled appearance occurs in other parts of the intestinal tract, giving an appearance much like a bunch of grapes.

The treatment of diffuse polyposis is essentially surgical. If the growth is small and fairly well circumscribed, it may be removed by excision. When large and at all spreading, it requires resection. Occasionally such procedures as gastro-enterostomy have been attempted but have failed. The lesion almost always requires complete extirpation.

HELIOTHERAPY IN EXTRA-PULMONARY TUBERCULOSIS

DR. RICHARD T. ELIASON, by invitation, said that his remarks were based on the work of the past three years in the heliotherapy demonstration at Chestnut Hill. This demonstration was organized to show what results could be

obtained with the use of heliotherapy in the extra-pulmonary forms of tuberculosis in children at this altitude and close to a big city. At the end of this period it is felt that the results have been most gratifying—so much so that the demonstration has been continued.

Of course the ideal location for the use of heliotherapy is one having both altitude and an atmosphere free from the smoke and dust raised by a large city. It is under such circumstances that the ultraviolet portion of the sun's spectrum is strongest, but the amount that penetrates to the ground in the outskirts of any large city is sufficient to be of great therapeutic value. It is well known that it is the ultraviolet band of sunlight that has the greatest therapeutic value but there is a growing feeling that the visible and infra-red regions also are of value and tend to augment the effects of the ultraviolet. Heliotherapy is really much more than just the use of the ultraviolet radiation derived from the sun and should include fresh air baths, rest, diet and a strict adherence to all well established conservative orthopædic practices. Spring and early summer are the best times for heliotherapy for then the ultraviolet portion is strongest. Also the air temperature is such that the middle of the day can be used. In the summer the heat of the day should be avoided and the morning and afternoon hours used. Fresh air baths are an important factor and are responsible in large part for the marked muscular development, and the excellent state of general nutrition that these children show. All children and especially those that are emaciated or are acutely sick must be acclimatized gradually to the fresh air before they are exposed to the sun. Diet needs no special comment except to insist that it be plain, of sufficient amount and contain the necessary building materials. Rest is second only to the ultraviolet in importance and in some cases even more important because if the diseased part is not put

FIG. 9.—Result of heliotherapy in extra-pulmonary tuberculosis.

at rest no amount of ultraviolet will bring about cure. During the acute stage, especially in bone and joint involvement, absolute rest of the part is essential, and this rest must be continued until there is X-ray evidence that there has been healing of the diseased area. Even then an additional four to six months will reduce the number of recurrences. After the subsidence of the acute stage gradual increase in motion can be allowed as it prevents ankylosis but weight bearing should not be allowed for several years. The last factor in heliotherapy is an adherence to accepted orthopædic teaching in all respects except one. We must continue rest in the strict orthopædic sense and we must continue the usual methods for the prevention and correction of deformity, but heliotherapy has introduced one marked departure from the usual teaching. We have been taught that ankylosis, as firm and enduring as possible, is to be sought in all cases involving joints but the introduction of heliotherapy has shown that healing can take place without ankylosis and that a surprising amount of motion can be returned to many of these joints. This, in the speaker's opinion, is the most important change that the use of heliotherapy has brought about. For ultraviolet is not a specific cure for any type of tuberculosis but only puts the patient in the best possible condition to combat the disease with the means that he has within himself.

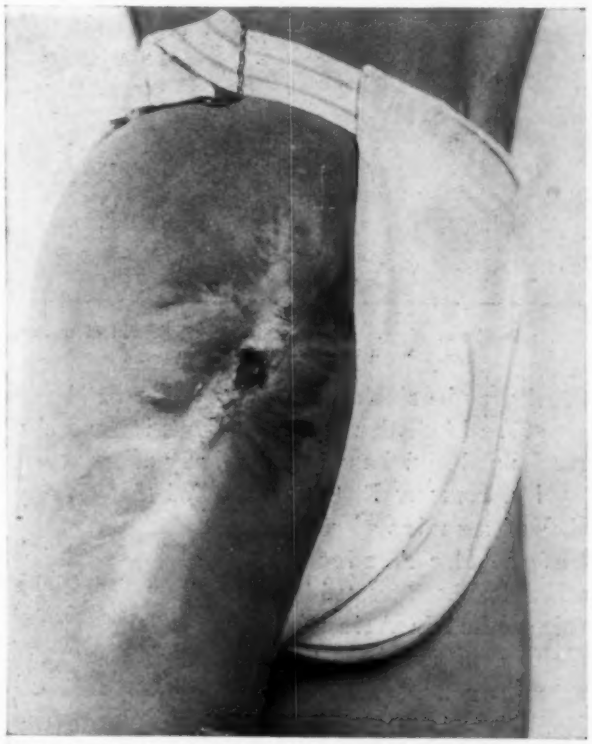

FIG. 10.—Result of heliotherapy in extra-pulmonary tuberculosis.

Just what are the benefits that can be expected from the use of heliotherapy in this type of tuberculosis? First the general results are an enrichment of the blood both in its hæmoglobin and cellular contents, a better appetite and a better digestion, an increase in metabolism, resulting in an increase in general nutrition and the development of a firm musculature and also a change in the mental attitude that in many children is truly remarkable. All these results are well illustrated by the pictures of Case 1 and the general pictures of Case 2.

The local effect on ulcers, sinuses and open wounds is well seen in the pictures of the local lesion in Case 2. Sinuses at first have a more profuse and

thinner discharge but soon tend to heal. Ulcers show healthy granulation tissue and a marked tendency to epithelialize. There is also a marked tendency to calcification of rarified bone as can be seen in Case 3. There is also a marked tendency to an increased rate of absorption of fluid from the peritoneal and pleural cavities.

FIG. 11.—Site of disease at elbow, showing limitation of motion, when treatment was begun.

The amount of function that can be restored to a seemingly hopelessly involved joint is well shown by Case 4.

These results are not limited to cases with tuberculosis but can be duplicated and even excelled in non-tuberculous conditions. Equally favorable results can be obtained in adults. DOCTOR ELIASON thinks that a more extensive use of heliotherapy by surgeons in general would lead to very gratifying results and would amply reward any effort necessary.

DR. HUBLEY R. OWEN recalled that three years ago, Dr. A. Bruce Gill showed a series of cases before the Academy, which had been treated by this method in Atlantic City. Two years ago the speaker had visited Rollier's colony and was impressed with the remarkable muscular development in the patients which he saw. There was also a striking absence of wasting and anemia in practically all cases. Doctor Owen said that very little surgery of any sort was done on these patients; for example, tuberculous empyema is never operated upon or even aspirated. Cases of Pott's disease are treated without plaster cases or fixation of any sort.

FIG. 12.—Same case as shown in Figure 11, after two years' treatment.

DR. WALTER G. ELMER said that the chief difficulty is lack of facilities for carrying out the treatment. In the Orthopædic Department of the Philadelphia General Hospital, and also in that of the Graduate Hospital of the Uni-

versity of Pennsylvania, the Social Service Departments have great difficulty in placing patients in sanitariums in the country where they can receive the open-air sunlight treatment. Quite a number of them are sent to the Children's Seashore House in Atlantic City, where about 500 can be cared for

FIG. 13.—Tuberculosis of ankle, condition when treatment was begun.

FIG. 14.—Same case as shown in Figure 13, after one year of treatment.

during the summer months—not so many in winter—and occasionally a child was admitted to the Chestnut Hill Sanitarium. If there were five times as many beds available in this latter institution, as there are at present, it could be kept filled throughout the year. It is exceedingly difficult to find a place for a patient over thirteen years of age.

There is no way of treating these patients that can compare with the open-air sunlight method.

Dr. Rutherford L. John said that Doctor Rollier does not use the lamps but depends on the sunlight entirely. Here one does not have the sunlight as constantly and so the lamp is of great help. The work which Rollier has done is magnificent, especially in the treatment of tuberculous disease of bones. The older idea that one should be content with arrest of the disease and permanent fixation of tuberculous joints, no longer obtains. Many cases treated by heliotherapy recover without loss of motion in the involved joint.

Dr. Richard T. Eliason (closing the discussion) said that he has not resorted to surgery in any of these cases. Some of the cases have had surgical treatment prior to their arrival at the institution, but it has not been found necessary to send any of them back for surgery. The sinuses have healed themselves fairly well except those of long standing, *i.e.*, over five or six years. Where the underlying lesion is a secondary infection, the sinuses are permanent although the amount of discharge is greatly reduced.

As to the lights, the initial cost of the carbon lamps is less than the mercury quartz lamp. There are other types of carbon arc lamps in use, one at the Taft Hospital in Cincinnati is designed for large groups of patients and consists of four large carbon arc lamps suspended from a central pivot. The patients are grouped around the light, the footboards taken off the beds, and the patients are so arranged that the light is cast on them perpendicularly, which tends to greater absorption. As to the comparative value of the carbon vs. the mercury lamps in the treatment of this type of lesion, the carbon arc lamp is considered to be the better for extrapulmonary lesions. The advantage of the mercury lamp is that with it one can give more ultraviolet rays in less time and this is of help in office work where one does not wish to clutter up his office by taking several hours to the one patient. In a number of clinics, especially in Germany, they use mercury lamps reinforced with lamps giving visible light and heat as they believe this to be of value. Gauvain has stressed the value of fresh air as being responsible for the development of the musculature and the subcutaneous fat. He shows that in his treatment of patients at the seashore where children who are unable to walk are carried out into the water the estimation of the metabolic rate before and after shows an increase of about 1000 per cent. He thinks that it is the "kick" which is gotten from the hydrotherapy which is responsible for the body musculature. Fresh air is really half of the game. The ordinary treatment rooms for heliotherapy apparatus are generally very badly ventilated and much of the benefit is thereby lost. Rollier starts his patients with fresh air baths, even before putting them in the sun. This is practiced at Chestnut Hill, the children's garments are taken away from them one by one until they end up in the G-string. With bed patients the amount of bed clothing is reduced until the patient is entirely exposed and they are then put in the sunlight.

SUPPURATIVE PERICARDITIS

Dr. Emory G. Alexander pronounced the annual oration entitled "Suppurative Pericarditis from the Surgical Viewpoint", for which see p. 801.

BRIEF COMMUNICATIONS

CONGENITAL VENOUS CYST OF THE MEDIASTINUM

A CONGENITAL venous cyst of the mediastinum, so large as to produce serious obstruction to respiration and to venous return through the innominate veins, is sufficiently unusual to warrant its being recorded. I have been unable to find a report of a similar case.

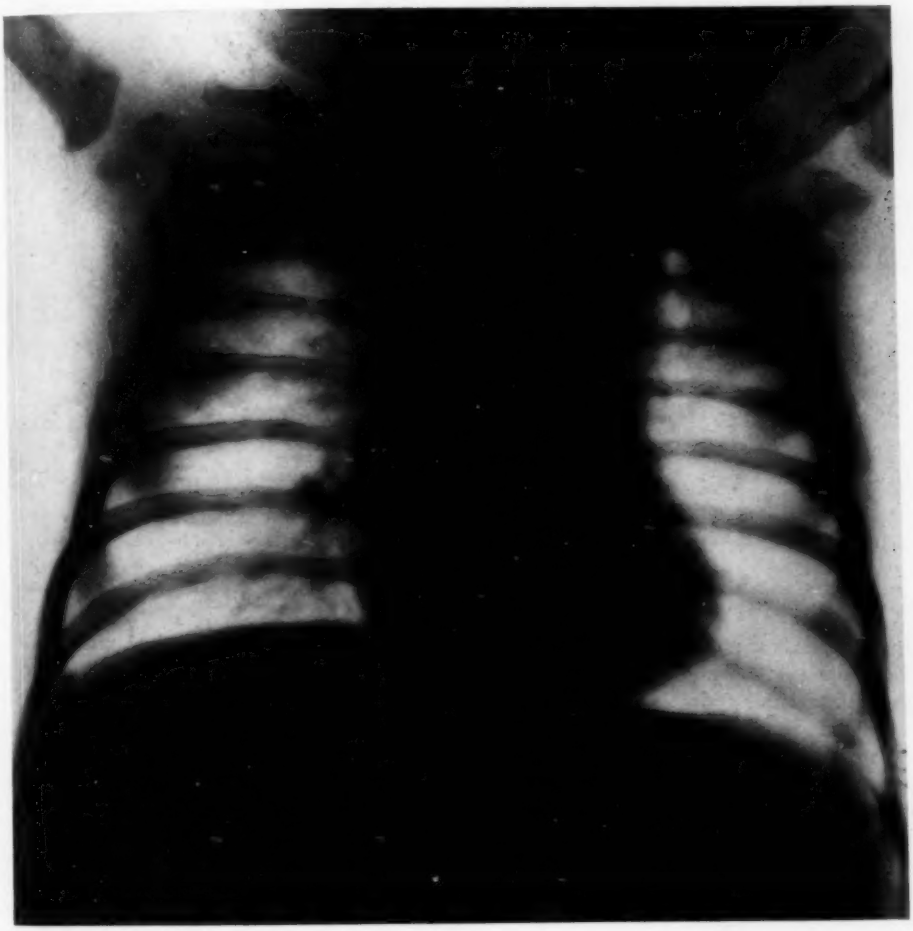

FIG. 1.—Skiagram of the infant's chest at the time it was first seen. Note the enormous widening of the mediastinal shadow which was misinterpreted as being due to a greatly enlarged thymus. X-ray treatment did not reduce the size of this shadow or cause the disappearance of her symptoms.

A female infant, five months old, was brought to the Out-Patient Department of the Hospital for Sick Children with the complaint that for four weeks she had suffered from (1) a swelling on the right side of the neck, (2) a peculiar spasmodic cough, (3) a hoarse cry, and (4) attacks of cynanosis.

Examination revealed a normal baby except for the swelling in the neck and its associated signs. Beneath the lower end of the right sternomastoid was a rounded swelling approximately the size of an egg. The size of the mass was not constant, however, but varied with respiration. On forced expiration, as in crying, it became much larger, and during inspiration it diminished greatly. The walls were soft and thin. Fluctuation was readily elicited. The mass had not the firm induration of an inflammatory mass nor the resistance of a branchial cyst. There was no corresponding mass on the opposite side. Redness, tenderness or other evidences of inflammation were not present. The temperature was normal and the throat was not inflamed. No enlarged

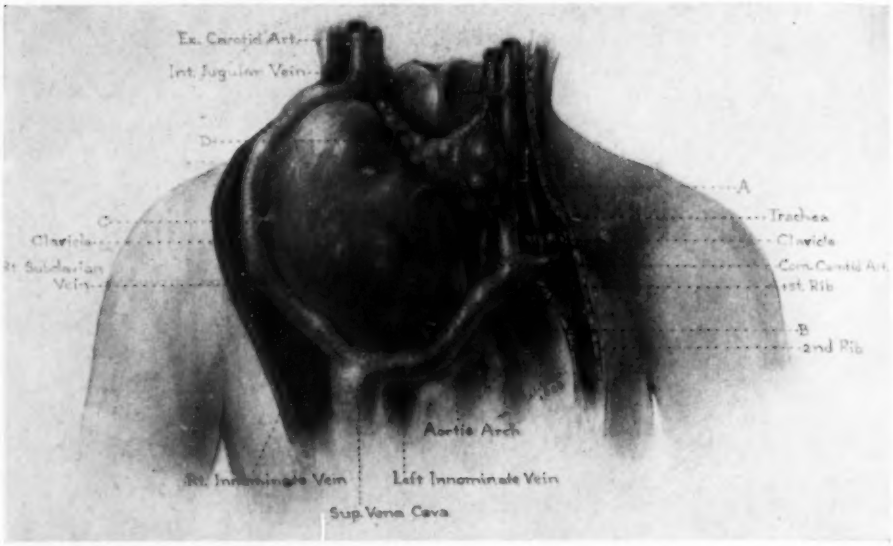

FIG. 2.—Drawing of the cyst and its relations, reconstructed from operative and post-mortem findings. A, B, C and D represent the venous radicles by which the cyst communicated with the surrounding veins. It was rupture of the radicle "A" which permitted collapse of the cyst.

cervical glands could be felt on either side. The infant's cry was peculiarly hoarse, and from time to time a spasmodic cough distressed the child. The face was constantly cyanosed and this cyanosis was noticeably increased when the child cried.

The tumor felt like a greatly enlarged jugular vein, but a diagnosis between this and a cystic tumor lying upon the jugular vein and pushed into greater prominence when the vein was distended was not possible. In an effort to reach a diagnosis the tumor was aspirated. Pure venous blood was obtained, which proved sterile on culture. This appeared to confirm the diagnosis of dilated jugular vein. Such venous enlargement and the cyanosis pointed to some obstruction to venous return. In this connection, an enlarged thymus was thought of as a possibility. X-ray of the chest (Fig. 1) revealed an enormous mediastinal shadow in the region of the thymus, which was interpreted as a greatly enlarged thymus pressing upon the right innominate vein and causing the peculiar symptoms. The unilateral distribution of the signs could not be interpreted.

The child was treated for enlargement of the thymus by an adequate dose of X-ray. At the end of six weeks its condition was much worse, and X-ray showed no diminution in the size of the shadow. It then became evident that the shadow seen in X-ray could not be that of an enlarged thymus. The physical findings were much changed. Embarrassment of respiration was now extreme and cyanosis was constantly present. The tumor now projected above the clavicle and behind the sternomastoid instead of lying under the latter. It no longer fluctuated but gave the impression of being a solid rounded tumor about the size of an egg. It underwent the most extreme excursion

during respiration. During inspiration it completely disappeared behind the clavicle; during expiration it rose forcibly from behind the clavicle and projected into the neck. The range of this movement during forced respiration was four inches.

It was now felt that the mass was a solid mediastinal tumor, probably a sarcoma, and operation was deemed justifiable.

Under ethyl chloride and ether anæsthesia, the mass was exposed by means of a transverse incision across the right sternomastoid one inch above the clavicle. It proved to be an ovoid tumor about the size of a lemon, extending from the position it occupied in the neck downwards into the mediastinum. It had firm and clearly defined walls which were not adherent to the surrounding structures. It moved freely with respiration up and down in the mediastinum. It appeared at first to be solid, but in separating it from the thyroid a venous radicle was torn across, resulting in a gush of venous blood and the collapse of the tumor. It was then evident that it was a venous cyst. After collapse of the cyst no further hæmorrhage occurred, indicating that such venous communications as must have been present at one time were now obliterated. The mass was separated from the surrounding structures and removed. During the latter part of the long operation, the pulse and respiration failed rapidly and in spite of transfusion of blood and the administration of adrenalin, the patient died just as the operation was completed.

FIG. 3.—The appearance of the pathological specimen.

A post-mortem examination was performed. Data obtained from this and from the operation permit the following description: The mass was a venous cyst as large as a lemon. Its relations are represented in Fig. 2. It lay behind the right sternomastoid, right clavicle, right first rib and sternum. The trachea was covered by the mass and compressed by it. This accounted for the difficulty in respiration. The tumor filled the notch between the two innominate veins. It received two large radicles, one from the right jugular vein and one from the left innominate vein; and several smaller radicles from the inferior thyroid group of veins. The thyroid lay at the upper pole of the mass. There was no communication with the arteries.

Microscopic examination of the cyst wall showed it to consist of œdematous connective tissue containing a few muscle fibres. An intact endothelium lining was not present but here and there a few scattered endothelial cells were to be seen. The interior of the cyst was for the most part smooth. There were, however, a few sacculations, and here and there the crevices and slight irregularities were filled with thrombotic deposit which was undergoing organization.

COMMENT

I am unable definitely to classify this tumor. The possible conditions which might have given rise to it are (1) an organizing hæmatoma, (2) a cavernous hæmangioma, and (3) a congenital abnormality of the veins. The first suggestion seems hardly to be a possibility. There was no history and no

evidence of injury sufficiently severe to have caused such a hæmatoma. The mass was clearly defined and firm walled, and at one time it communicated with the surrounding veins by large venous channels—facts which seem incompatible with a hæmatoma. The second suggestion may be a possibility, but if this was a cavernous hæmangioma the single cyst was of enormous size and the distinction between such a cyst and a congenitally abnormal vein is ill defined. I am inclined to regard it as a venous cyst of congenital origin due to an abnormal arrangement of the primitive cardinal veins and their branches. While this appears to me to be the most likely possibility, it must be admitted that such an opinion does not explain all the clinical facts. At no time during the usual course of embryonic development does there exist a venous communication between the left innominate and right internal jugular veins. If it arose from an embryonic vein it must, therefore, have been derived from an abnormally placed one. Even though such a vein were present it would be more reasonable to expect it to persist as an abnormally placed vein than to expect it to become transformed into a steadily expanding venous cyst. I have submitted the data of the case to Prof. J. P. McMurrich, of the department of anatomy of the University of Toronto, who has kindly examined them for me. He was not able to suggest any embryonic structure of which it might be a development.

There are features other than its origin which are equally puzzling. Symptoms of venous and respiratory obstruction did not occur until the last ten weeks of the child's life, and during this period the evidences of obstructions steadily increased in intensity. This would indicate that the mass was at first small and later increased in size. Moreover, when first seen the cyst communicated freely with the great veins, as indicated by its collapse during inspiration and the failure of aspiration to diminish its size. Its apparent solid nature six weeks later, and the lack of bleeding after the cyst had been opened indicated that the free venous communication had been obliterated. I am inclined to the opinion that the X-ray treatment had something to do with this alteration in its nature.

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THE APPENDIX AS A PROVISIONAL ORGAN

The appendix has hitherto been regarded as the vestigial remnant of former development, and in consequence thereof students have been trained to fall upon and destroy it without mercy whenever it could be approached. Some recent experiences of mine have caused me to pause and speculate concerning its history and purpose, and I am constrained now to regard it as a *provisional rectum,* to be so used in emergencies that render drainage and relaxation of the large bowel a matter of extreme importance. Its location can be seen at a glance to be strategic, allowing access to both the large and the small bowel and communicating with the portion of the large bowel in which the contents are still liquid. To reach the cæcum from the

rectum a distance of five or six feet must be traversed over a difficult and tortuous route, against obstacles and through much pain to the patient, while to reach it through the provisional rectum, a term which I am pleased to apply to the appendix, requires only the thickness of the abdominal wall, probably two to four inches, and that over a straight and direct, unobstructed, uncomplicated pathway.

I am fully aware that what is known as appendicostomy has for many years been employed for treatment of ulceration and other affections of the colon. In other words the purpose has been to achieve the introduction of medication for local therapeutic contact with the bowel. If we judge by the rarity of the application of this procedure, its usefulness must be in grave doubt; while the aims I have sought to make the organ serve are locally to drain and constitutionally to obtain absorption of fluids and nourishment.

The cases in which I have used this method are fifteen in number, and represent the types of abdominal cases that after the operation become afflicted with ileus, distention, peritonitis and death. One case more illustrative than the others consisted in an old abscess of the right tube which made it necessary to resect the bowel in the presence of pus and the peril of general peritonitis. Another representative case of the group was a perforated gastroduodenal ulcer with a hole as large as a lead pencil and the abdomen filled with gastric and duodenal contents. Also, one case of delayed operation for obstruction that looked hopeless. The method employed is to cut and tie the meso appendix, which gives the appendix extensive freedom. The appendix is then pulled through the lower angle of the operative incision, bringing the cæcum against the parietal peritoneum. A sterile safety pin impales its mesenteric border which prevents its slipping back. The end is clipped off and a catheter of a size that will fit snugly is passed through its lumen well into the bowel. The incision is closed in the usual manner and the end of the catheter is left outside the dressing.

You will be greatly astonished at the number of perplexities this simple device will relieve. The large bowel can be readily drained both of gas and feces.

The whole of the large intestine can be filled with water or salines for its gradual absorption. Solution of Epsoms salts can be given in whatever quantity desired. Castor oil or any medicine that is indicated, all without fear of rejection, but with assurance of therapeutic result.

In about six days the appendix sloughs and the catheter can be removed if it has served its purpose. It can be allowed to remain as long as there seems to be any need for it. As soon as the catheter is removed the opening closes promptly. There never has been any hint of a fecal fistula resulting. Fourteen of the fifteen patients I have used it on so far have recovered.

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BOOK REVIEWS

OPERATIVE SURGERY. By J. SHELTON HORSLEY, M.D. Third edition. Large Octavo, Cloth, 893 Pages. St. Louis, Mo., C. V. Mosby Co.

This admirable book of Horsley's was reviewed in the ANNALS OF SURGERY of August, 1924. It was then a book of 721 pages. In the years that have followed it has now reached its third edition and has grown to a book of 893 pages.

Its special merit and peculiarity rests in the fact that it describes the author's own experiences. There is no attempt made to describe all surgical operations. The work, while not complete, is comprehensive. The outstanding feature of the work is the emphasis placed upon the physiologic functions and the interpretation of the biological processes that follow surgical operations. It is a book more to be applied by one who has already arrived at some surgical experience than one to be used by a medical undergraduate. For the philosophical surgeon as well as for the practical operator this book will be accepted for frequent consultation. LEWIS S. PILCHER

THE DUODENUM. By PROF. PIERRE DUVAL, M.D., JEAN CHARLES ROUX, M.D., and HENRI BECLERE, M.D. Pages 205. Octavo. C. V. Mosby Co., St. Louis, 1928.

Of late years much deserved attention has been directed to the question of the pathology, symptomatology and treatment of diseased conditions of the duodenum other than simple ulcer. The symptom complex presented in many instances is rather suggestive. There has, however, not been any concerted publication relative to the various conditions causing these symptoms until the present one which emanates from France, and is a compilation of the observations of a physician, a surgeon and a radiologist with collaboration of a chemist. It has been translated by E. P. Quain and represents an intimate fusion of the data acquired by each, submitted to each other for mutual criticism, and accepted by all.

To many physicians who have been puzzled by unsuccessful treatment of cases of so-called dyspepsia, biliousness and that array of indefinite symptoms which have apparently baffled proper interpretation of the causative factor, the present treatise may serve to clear up many points. In fact, some cases of neurasthenia would appear to be due to this class of digestive trouble and may be found to be amenable to surgical treatment. A good

deal of our present knowledge of duodenal pathology, particularly relating to obstructions, has been gained from the writings of one of the authors, Professor Duval, and we are very pleased to see that these observations have been collected and correlated with those of others in this present volume. This work consists of six chapters taking into consideration the relation of the duodenum in calculous cholecystitis, essential and stenosing periduodenitis, compression of the duodenum by the mesenteric pedicle, duodeno-jejunostomy, the question of duodenal ulcer and a most important chapter on the picture presented by intoxication due to duodenal retention.

Thus, not only to the clinician but also to the surgeon, the book is recommended as suggestive of many problems which its perusal will serve in some measure at least to elucidate.

DISEASES OF THE GALL-BLADDER AND BILE DUCTS. By E. A. GRAHAM, M.D., W. H. COLE, M.D., G. H. COPHER, M.D., and S. MOORE, M.D., Octavo, cloth, pages 456. Lea and Febiger, Philadelphia, 1928.

It is interesting to realize that notwithstanding the enormous number of articles published bearing on this subject during the past decade, and an increasing realization of the importance of this viscus and its diseases, there has been no comprehensive discussion of this subject since 1905, when Rolleston's treatise appeared.

A most careful consideration is therefore most timely when one appreciates that the authors are able to state that from 20 to 25 per cent. of all adults have gall-stones and probably an equal number have cholecystitis without stones, concluding therefore that approximately 40 per cent. of our adult population have disorders of their biliary tract.

In the present work, while the authors have endeavored to present the subject in a systematic way, particular emphasis has been made of the more newly discovered knowledge of the gall-bladder, especially in regard to its physiology and the diagnosis of its disorders by new methods.

Cholecystography has been presented in detail by the authors having a paternal interest in its development, and shows that much of the criticism against its employment has really been due to a failure to understand its underlying principles, to inaccuracy of interpretation and to poor technic both in the administration of the substances and in the taking of the Röntgen-ray films.

Another most interesting and important discussion is that relative to the application of the various tests for hepatic function and its relation

to the diagnosis of biliary disease. The technic of the van den Bergh and the authors' test is given in detail, as are several others.

The surgical aspects of the treatment have been extensively and adequately presented to the exclusion practically of the question of medical care, as the authors feel that the latter is inefficient, except as it is used symptomatically and as a means of preparing patients for operation.

The work is profusely and well illustrated. The radiographic films are particularly informative and well produced.

JAMES T. PILCHER

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